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Ono

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(54) **IMAGING CONTROL SYSTEM, CONTROL APPARATUS, CONTROL METHOD, AND STORAGE MEDIUM**

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Sep. 6, 2010 (JP) 2010-198775

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H04N 5/232 (2006.01)
H04N 5/225 (2006.01)
G08B 13/196 (2006.01)

(52) **U.S. Cl.**
CPC ***H04N 5/225*** (2013.01); *G08B 13/19691* (2013.01); ***H04N 5/232*** (2013.01)

(58) **Field of Classification Search**
USPC 348/211.9, 211.99, 208.3, 14.1, 143, 348/169
See application file for complete search history.

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(57) **ABSTRACT**

A control apparatus for controlling an imaging apparatus capable of changing an imaging direction of an imaging unit in panning and tilting directions includes an acquisition unit configured to acquire a captured image captured by the imaging unit, and an provision unit configured to provide, together with the captured image, when the imaging direction of the imaging unit coincides with a panning rotational axis for rotating the imaging direction in the panning direction, a panning direction guide for indicating that changing the imaging direction in the panning direction rotates the captured image around an intersection of an optical axis of the imaging unit and a plane containing the captured image.

21 Claims, 16 Drawing Sheets

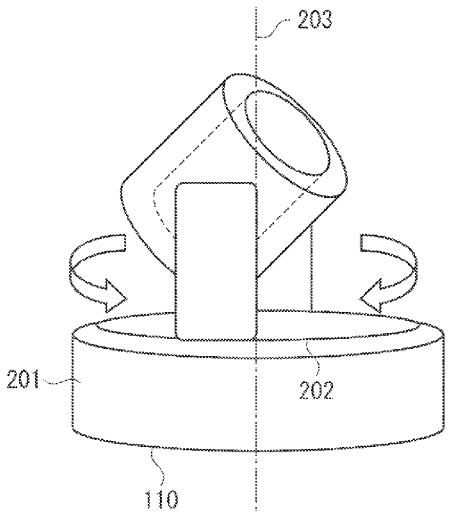


FIG. 1

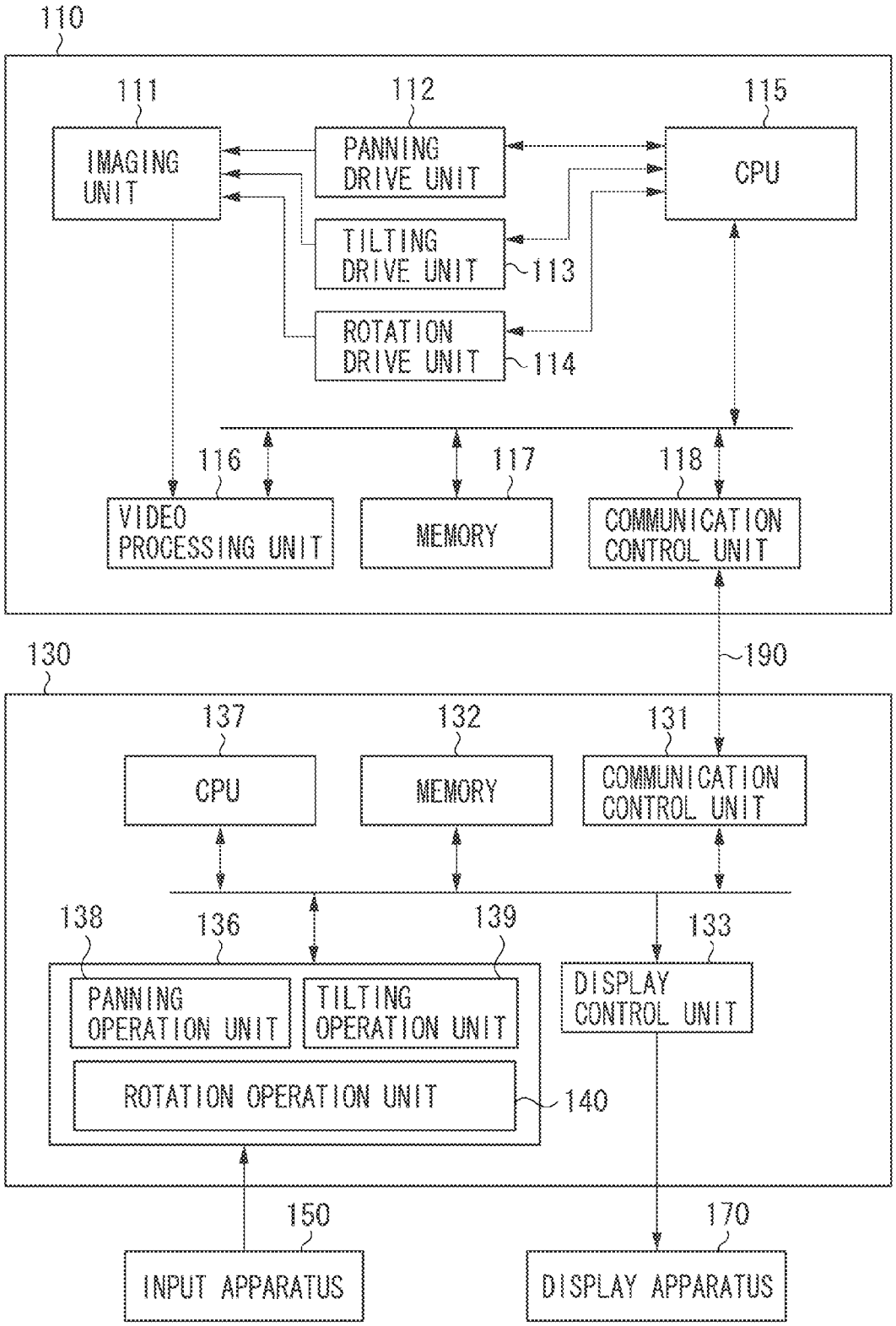

110
111
IMAGING UNIT
112
PANNING DRIVE UNIT
TILTING DRIVE UNIT
113
ROTATION DRIVE UNIT
114
115
CPU
116
VIDEO PROCESSING UNIT
117
MEMORY
118
COMMUNICATION CONTROL UNIT
190
130
137
CPU
132
MEMORY
131
COMMUNICATION CONTROL UNIT
138
PANNING OPERATION UNIT
136
TILTING OPERATION UNIT
139
ROTATION OPERATION UNIT
140
133
DISPLAY CONTROL UNIT
150
INPUT APPARATUS
170
DISPLAY APPARATUS

FIG. 2A

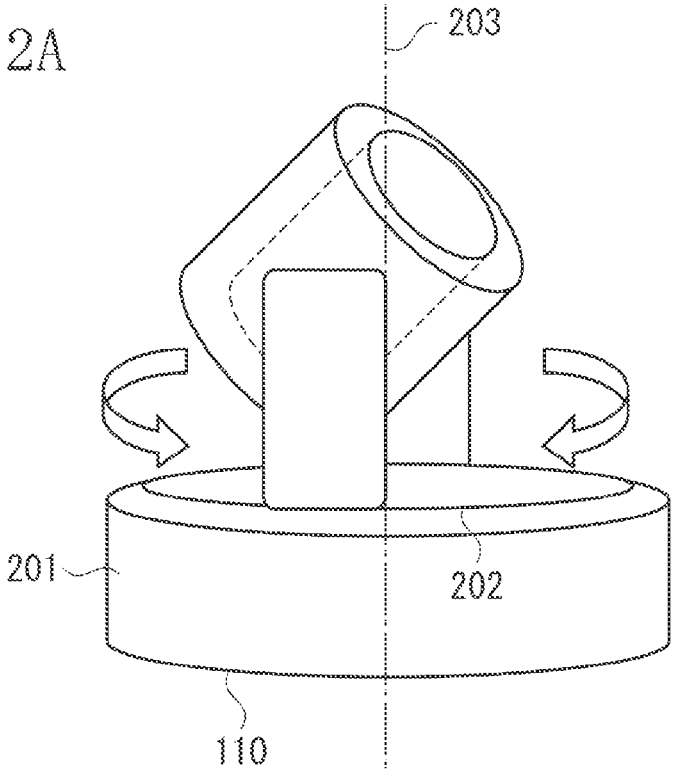


FIG. 2B

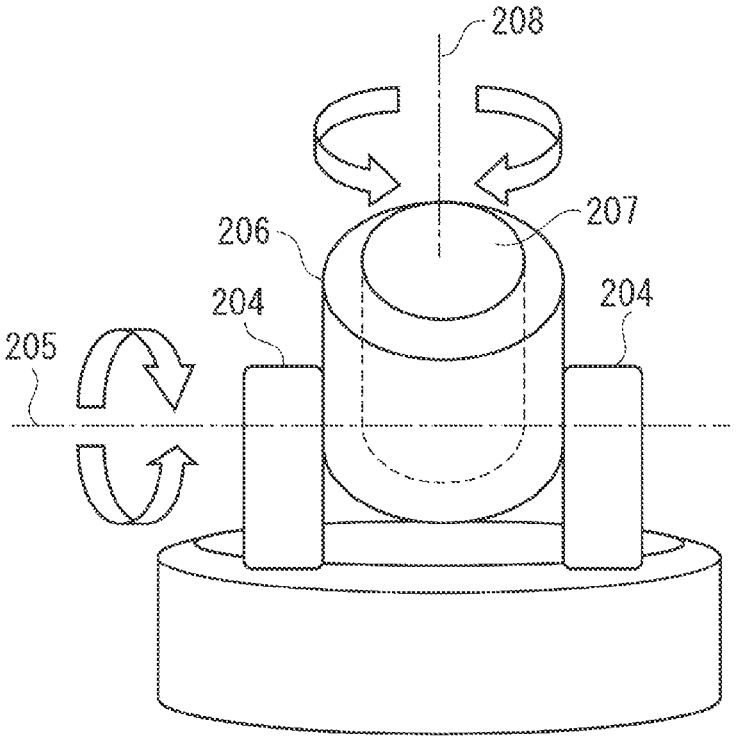


FIG. 3A

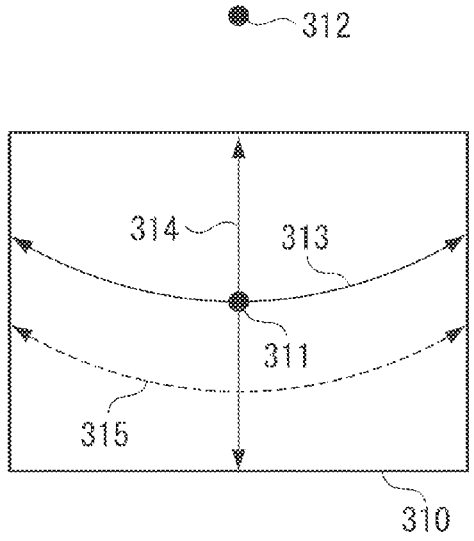


FIG. 3B

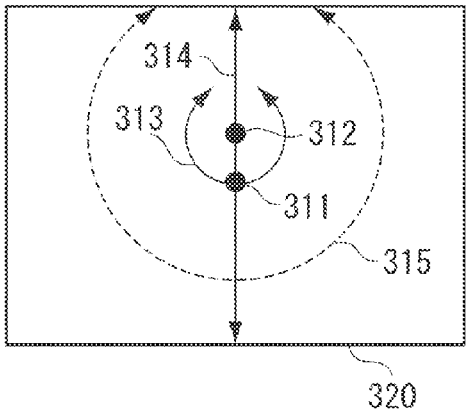


FIG. 3C

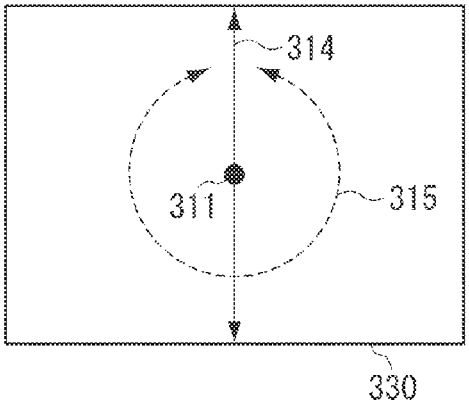


FIG. 3D

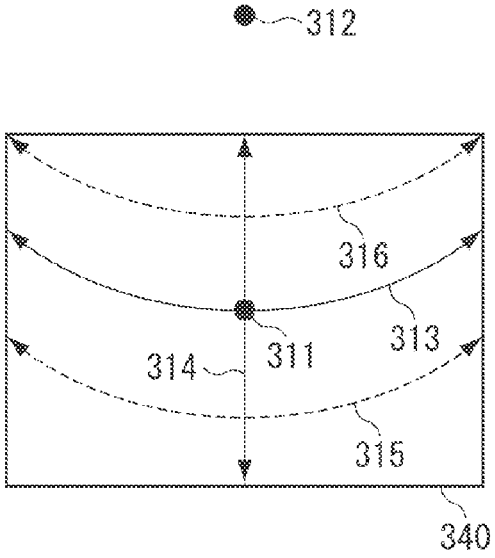


FIG. 3E

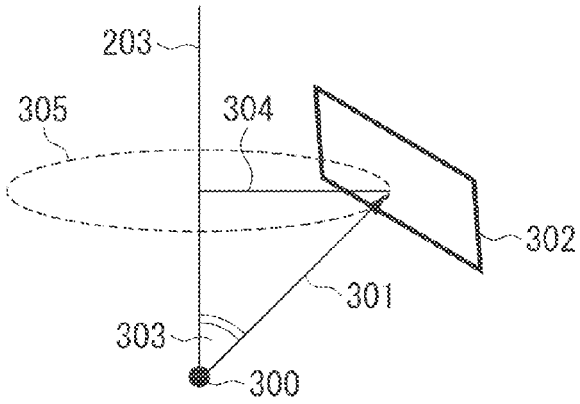


FIG. 3F

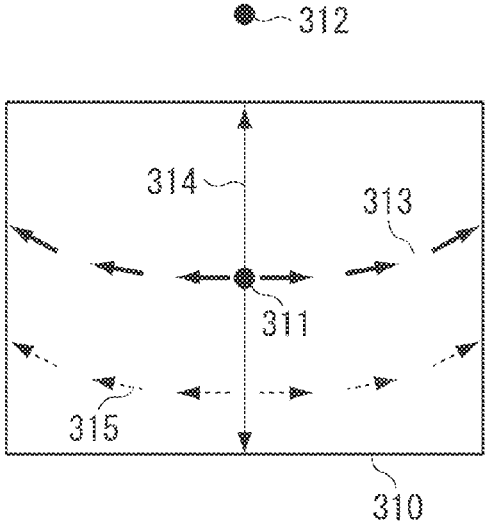


FIG. 4

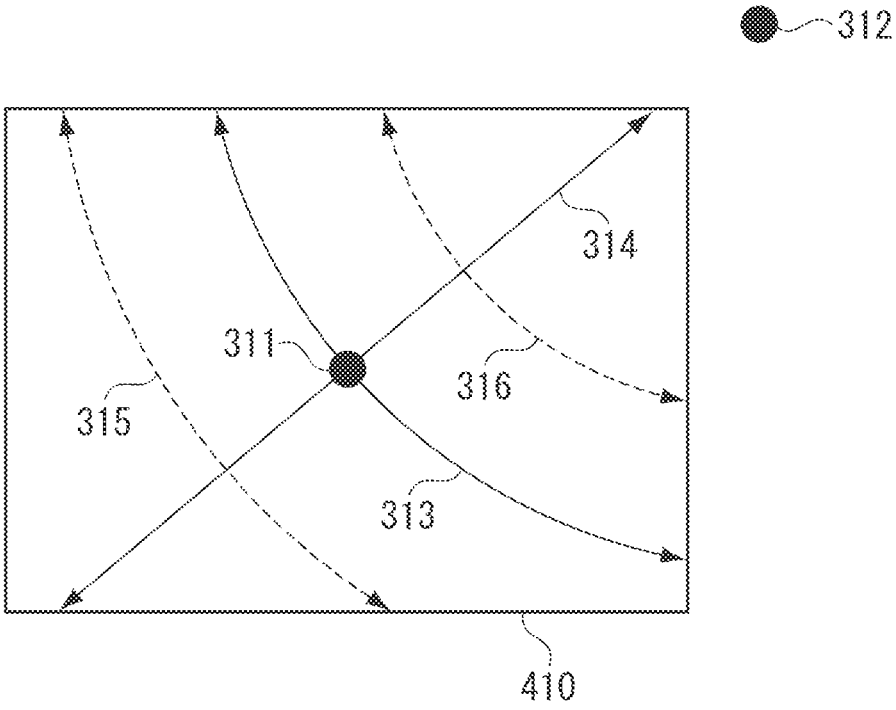


FIG. 5

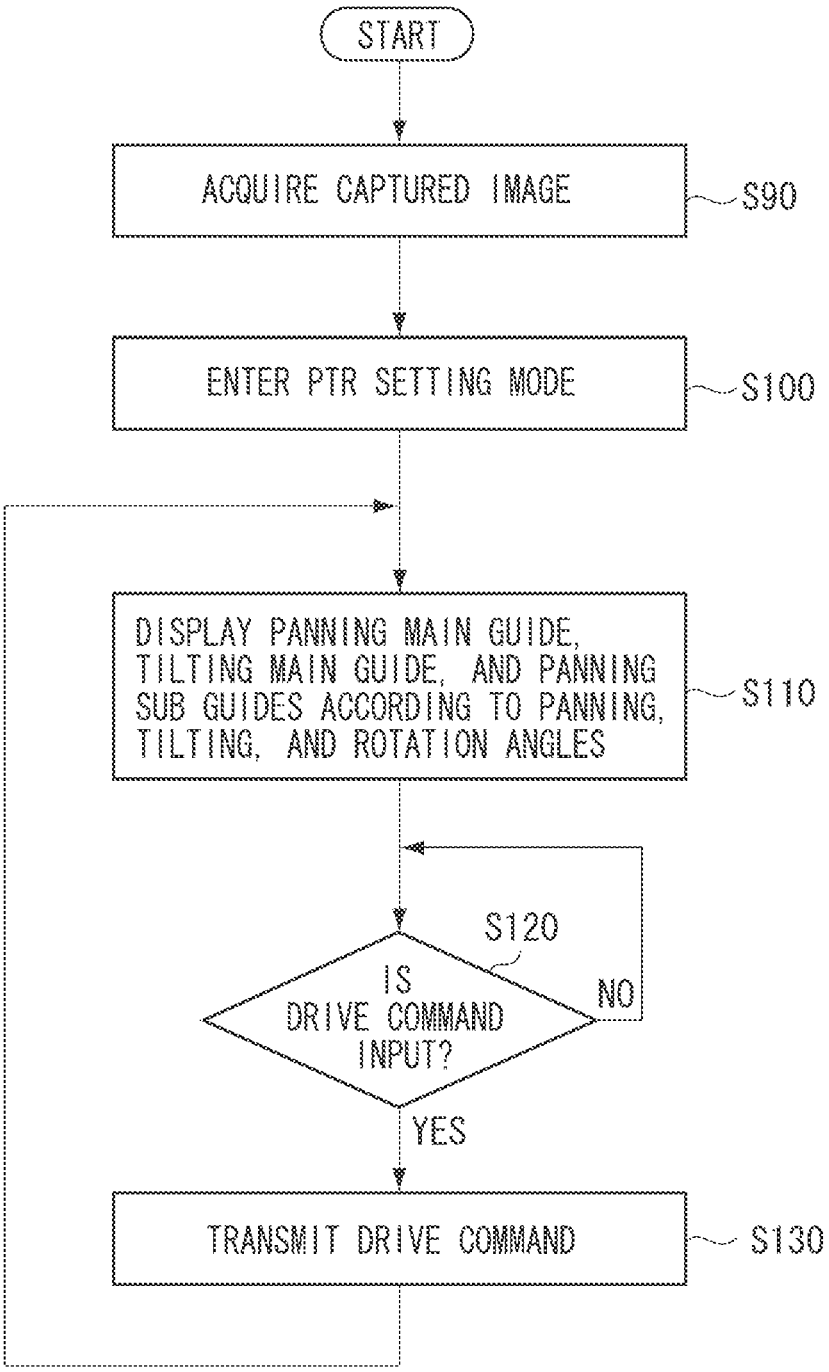

START
ACQUIRE CAPTURED IMAGE
S90
ENTER PTR SETTING MODE
S100
DISPLAY PANNING MAIN GUIDE, TILTING MAIN GUIDE, AND PANNING SUB GUIDES ACCORDING TO PANNING, TILTING, AND ROTATION ANGLES
S110
S120
IS DRIVE COMMAND INPUT?
NO
YES
TRANSMIT DRIVE COMMAND
S130

FIG. 6

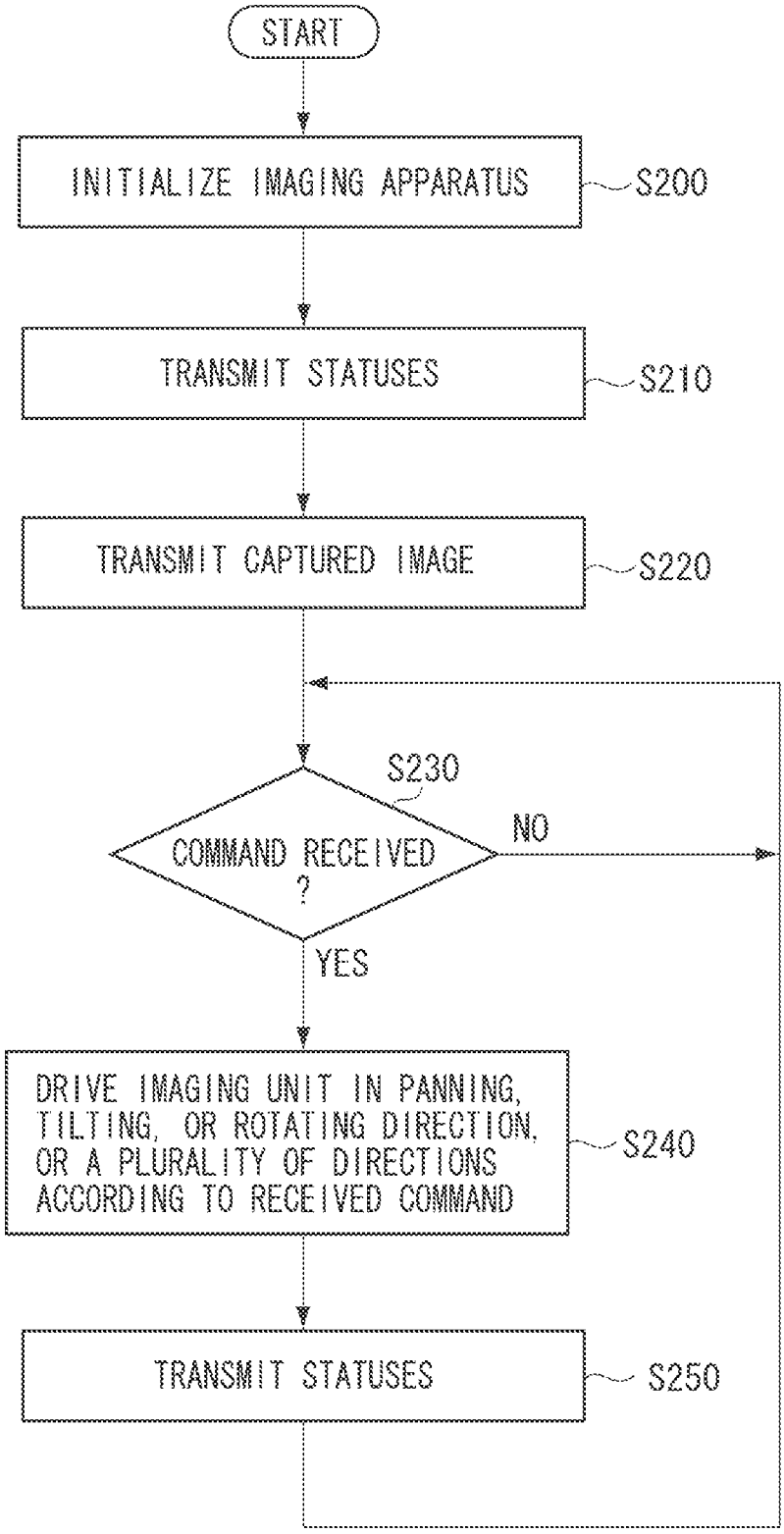

START
INITIALIZE IMAGING APPARATUS
S200
TRANSMIT STATUSES
S210
TRANSMIT CAPTURED IMAGE
S220
S230
COMMAND RECEIVED ?
NO
YES
DRIVE IMAGING UNIT IN PANNING, TILTING, OR ROTATING DIRECTION, OR A PLURALITY OF DIRECTIONS ACCORDING TO RECEIVED COMMAND
S240
TRANSMIT STATUSES
S250

FIG. 7A

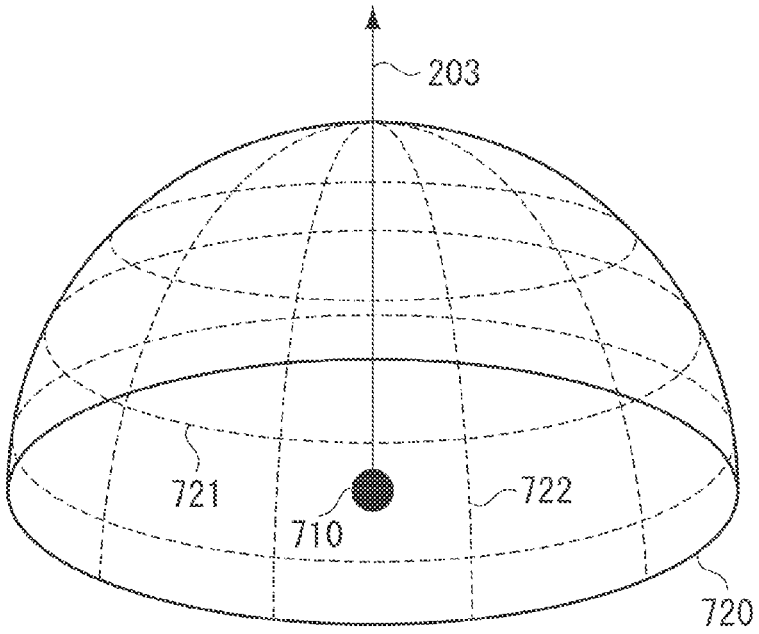


FIG. 7B

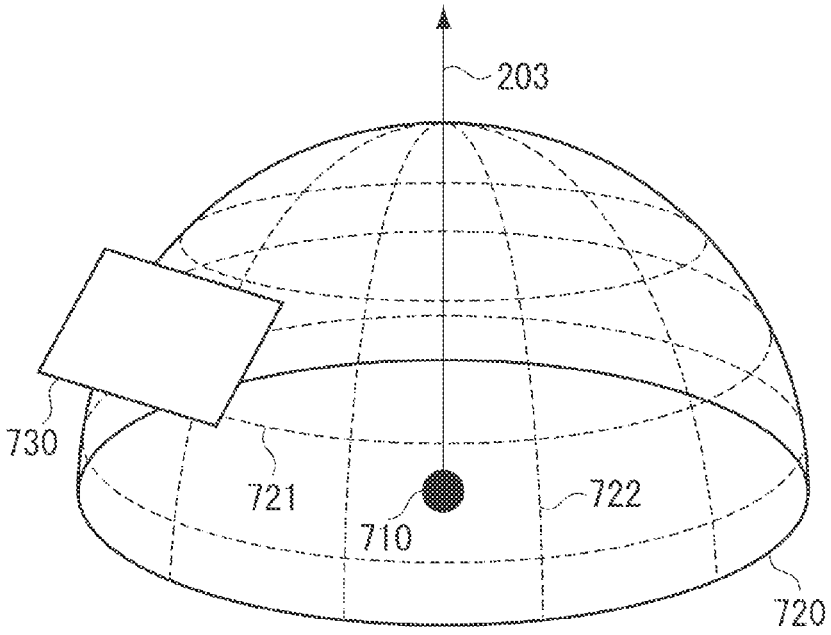


FIG. 8A

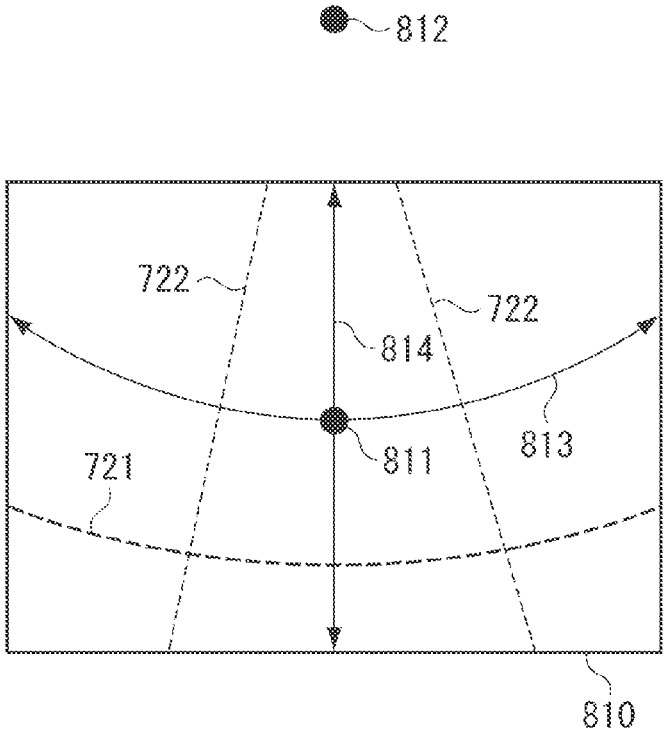


FIG. 8B

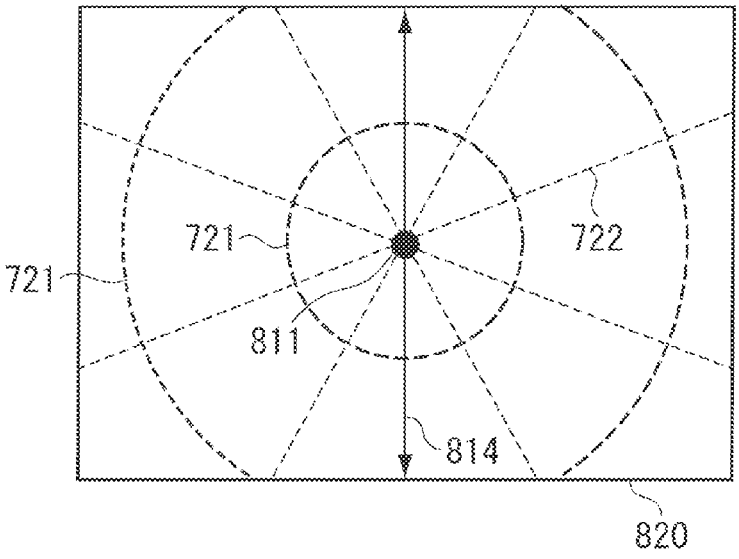


FIG. 9A

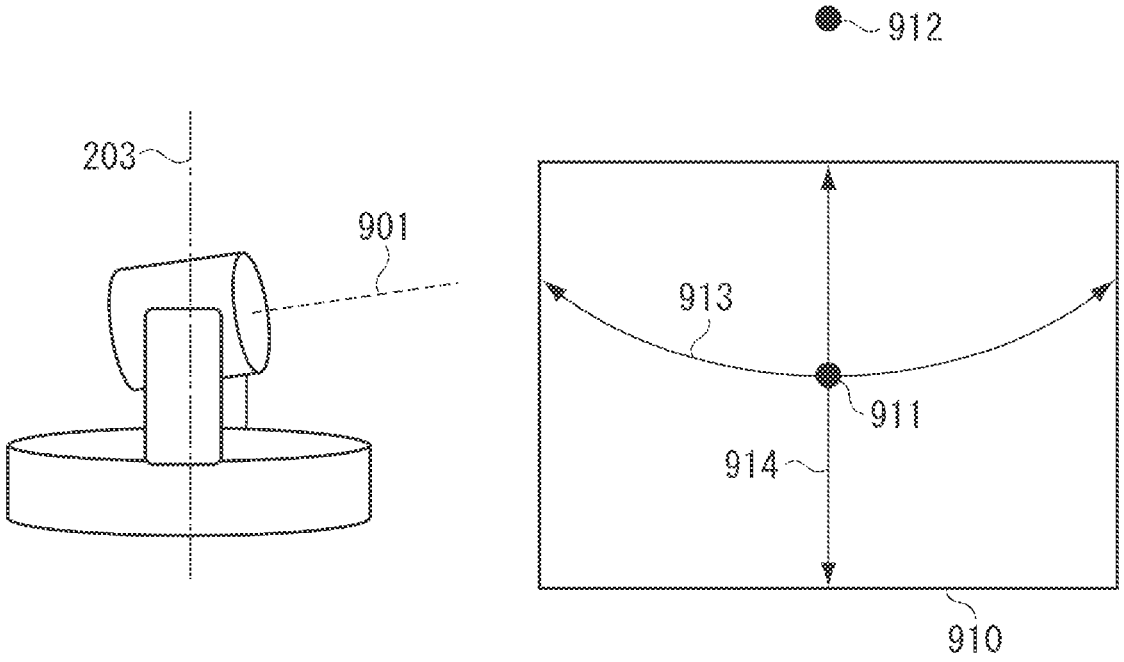


FIG. 9B

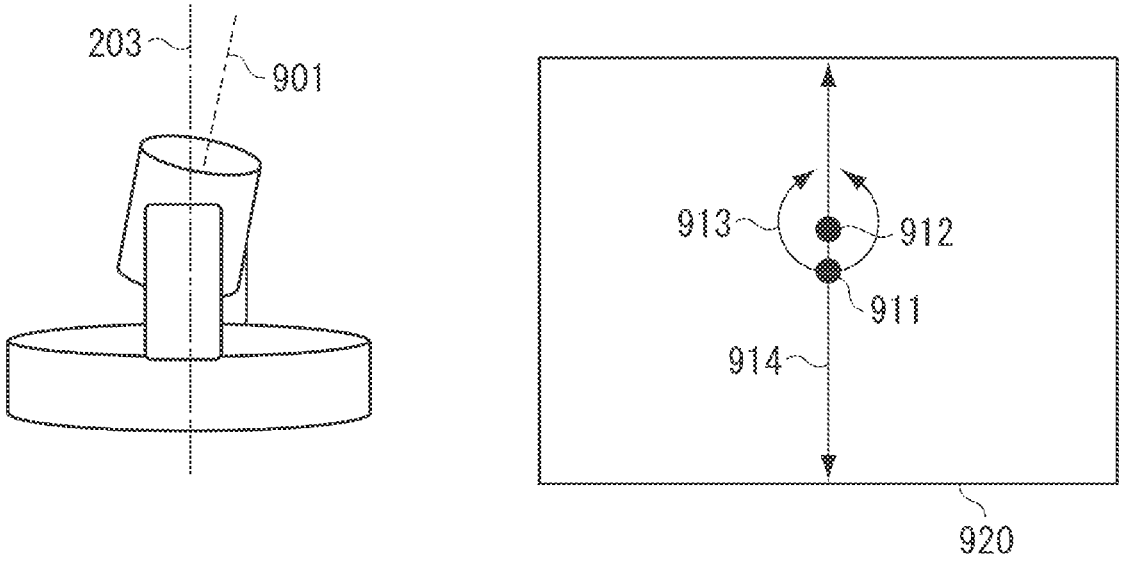


FIG. 10

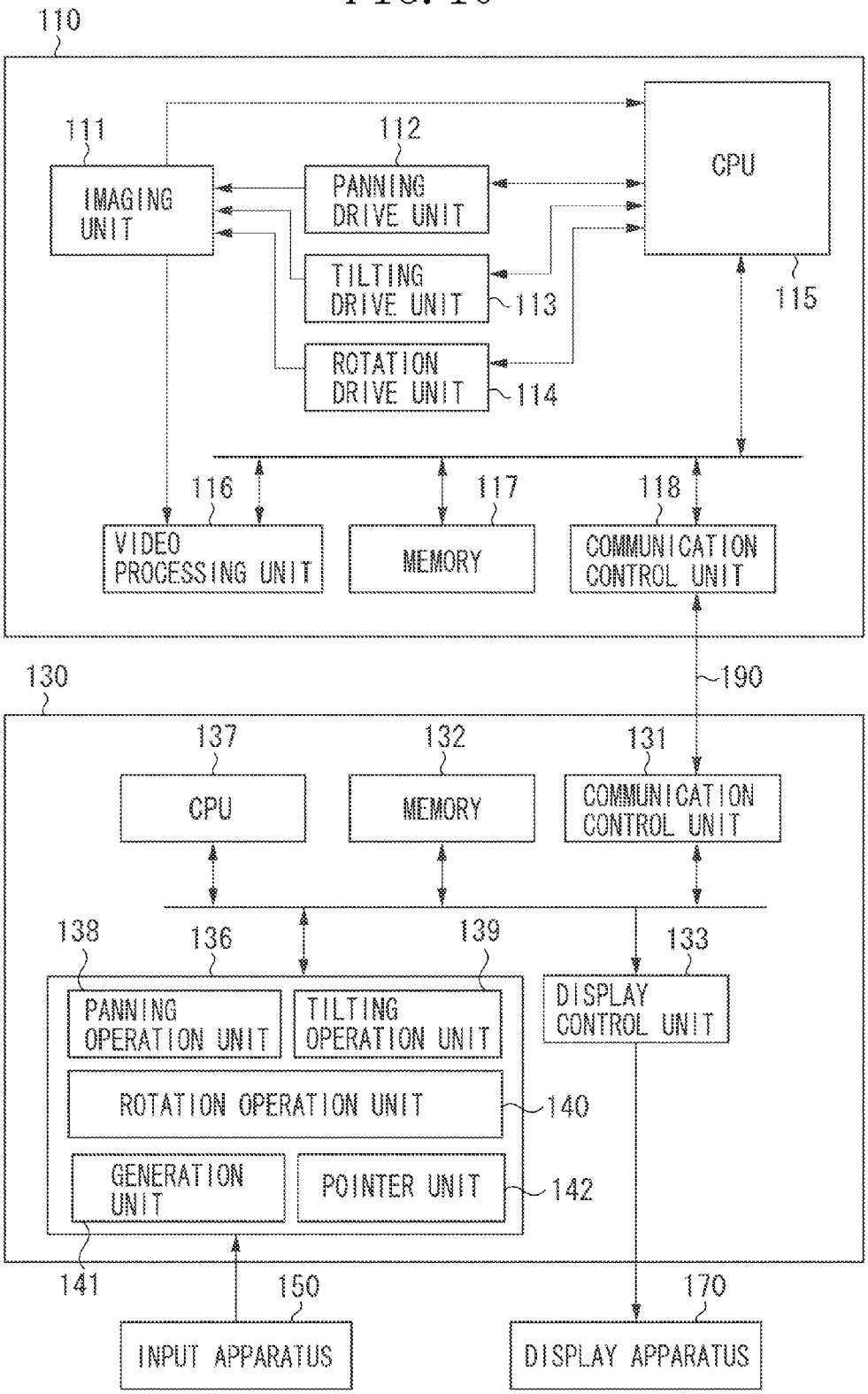

110
111
112
CPU
IMAGING UNIT
PANNING DRIVE UNIT
TILTING DRIVE UNIT
113
ROTATION DRIVE UNIT
114
115
116
117
118
VIDEO PROCESSING UNIT
MEMORY
COMMUNICATION CONTROL UNIT
190
130
137
132
131
CPU
MEMORY
COMMUNICATION CONTROL UNIT
138
136
139
133
PANNING OPERATION UNIT
TILTING OPERATION UNIT
DISPLAY CONTROL UNIT
ROTATION OPERATION UNIT
140
GENERATION UNIT
POINTER UNIT
142
141
150
170
INPUT APPARATUS
DISPLAY APPARATUS

FIG. 11A

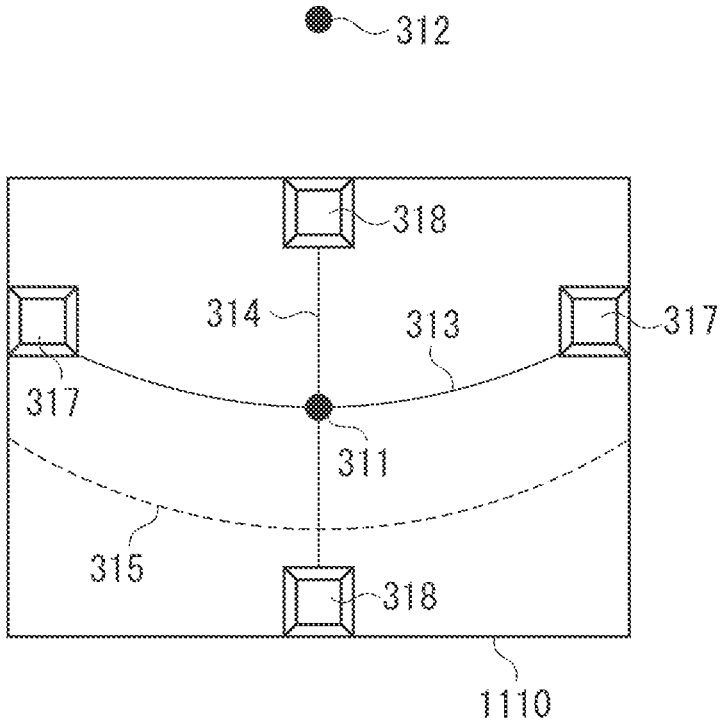


FIG. 11B

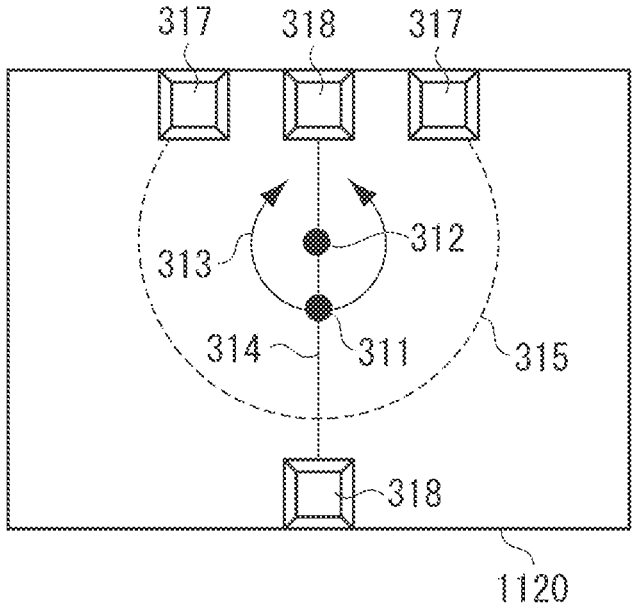


FIG. 11C

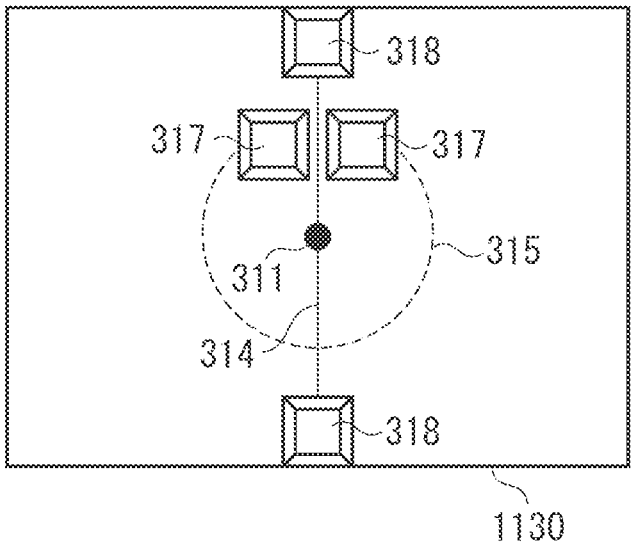


FIG. 11D

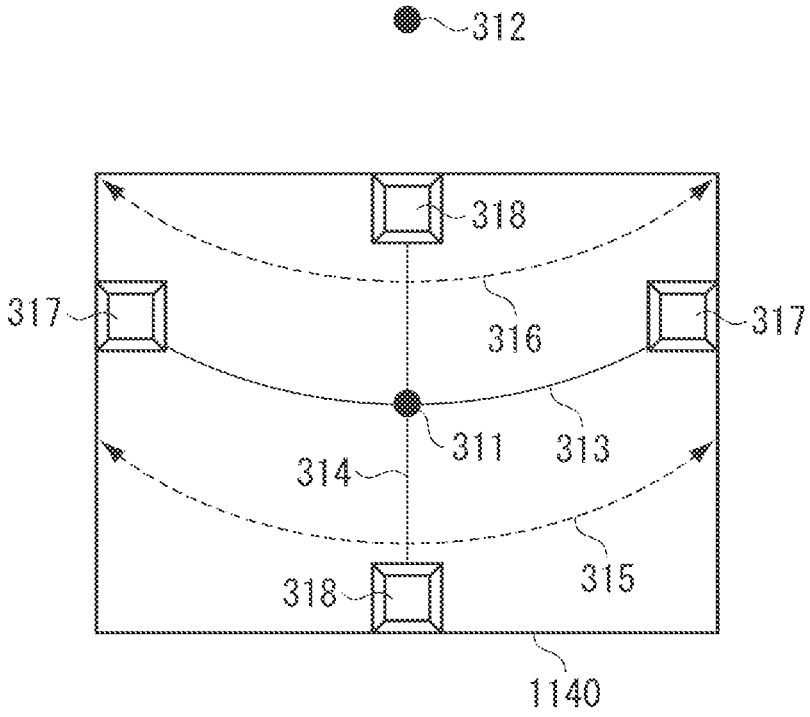


FIG. 12A

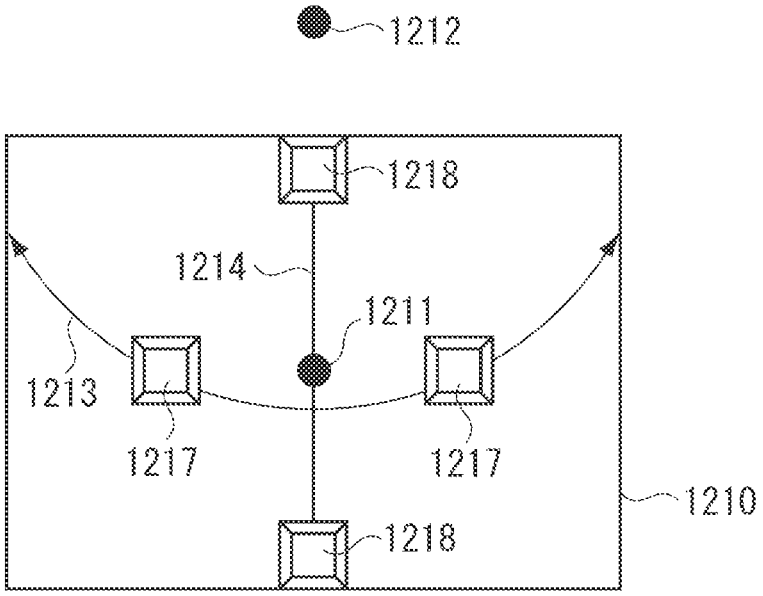


FIG. 12B

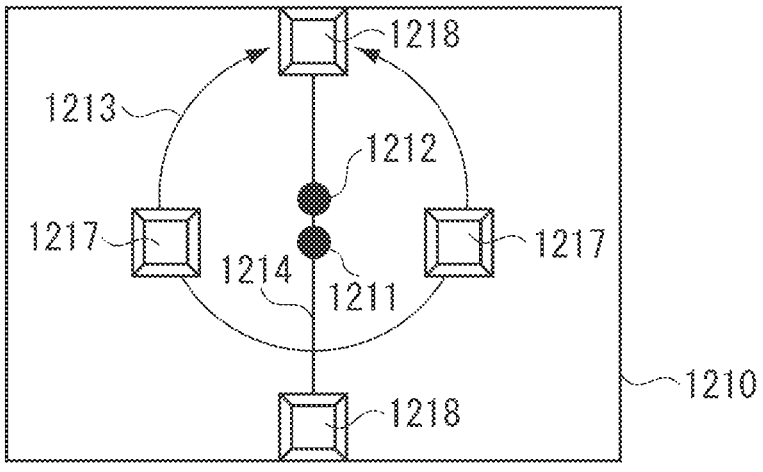


FIG. 12C

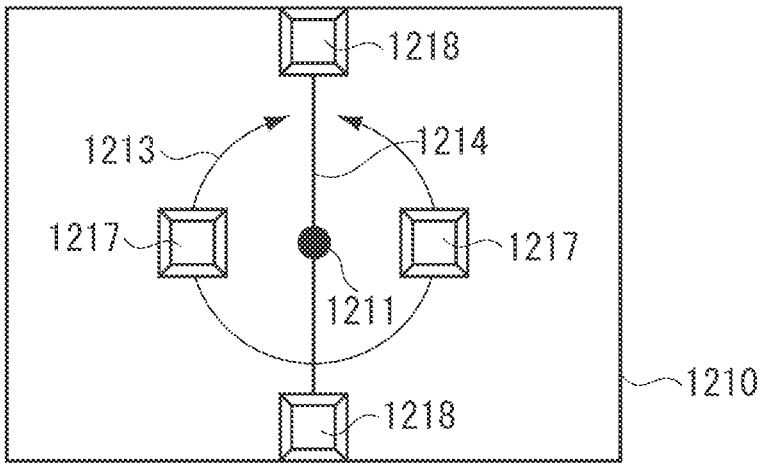


FIG. 13A

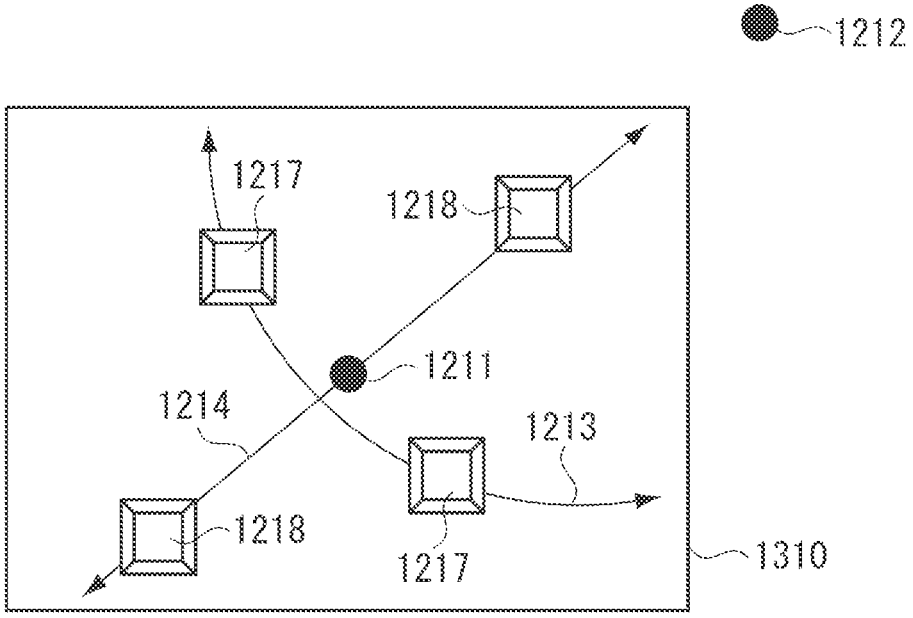
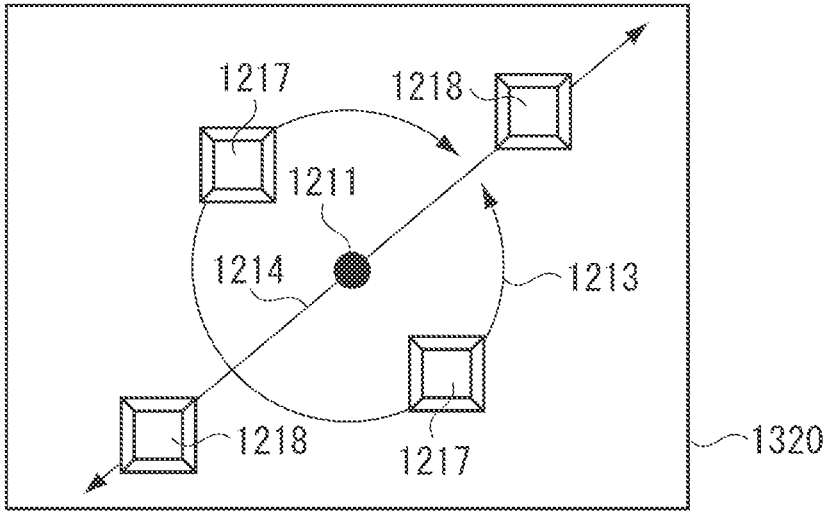


FIG. 13B



IMAGING CONTROL SYSTEM, CONTROL APPARATUS, CONTROL METHOD, AND STORAGE MEDIUM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an imaging control system for controlling an imaging apparatus, an apparatus and a method for controlling the imaging apparatus, and a storage medium.

2. Description of the Related Art

A conventional imaging control system includes an imaging apparatus connected to a network and a client apparatus which controls the imaging apparatus via the network. The imaging control system can control panning and tilting drive mechanisms of the imaging apparatus through operations on the client apparatus. A known imaging control system is directed, when driving an imaging apparatus for panning and tilting, to making it easier for a user to orient the imaging apparatus in the direction of a target object (for example, Japanese Patent Application Laid-Open No. 2004-266876). The imaging control system stores in a memory of an imaging apparatus a table for setting a relation between the panning angle and name display characters such as "North", "South", "East", and "West." The imaging control system orients the imaging apparatus to a panning angle corresponding to a name display character input by a user, and displays on a monitor the name display character corresponding to the direction to which the imaging apparatus is oriented.

A known method displays buttons for indicating the panning and tilting directions at predetermined positions around a captured image (for example, Japanese Patent Application Laid-Open No. 4-373386 and Japanese Patent Application Laid-Open No. 8-237533). However, there has been a case where the conventional method cannot suitably show a user the imaging direction since the panning and tilting directions dynamically change in response to operations of the panning, tilting, and rotation mechanisms.

As a method for assisting the user to orient the imaging direction of the imaging apparatus to a target direction when driving the imaging apparatus for panning and tilting, the panning and tilting drive directions may be possibly superimposed onto the captured image, as illustrated in FIG. **9**A. When the user changes the imaging direction of the imaging apparatus to the panning or tilting direction, the method illustrated in FIG. **9**A superimposes onto the captured image as direction guides **913** and **914** a moving path to be traced by an imaging center **911** which is an intersection of a plane containing the captured image and an optical axis **901** of the imaging apparatus. However, when superimposing the panning and tilting drive directions, there arises a problem that the user cannot recognize the panning and tilting drive directions in a specific imaging direction in some cases.

A problem arising in drive direction display will be described below. Modes for displaying the drive direction on a display image and a change in panning direction display accompanying the operation of the tilting mechanism will be described below with reference to FIGS. **9**A and **9**B.

Referring to FIG. **9**A, the optical axis **901** denotes an imaging direction of an imaging apparatus, a display image **910** denotes an image displayed on a display apparatus, an imaging center **911** denotes a center of the captured image, and a panning rotation center **912** denotes the position of a panning rotation center on the display image **910**. Referring to FIG. **9**A, a panning direction guide **913** is a panning direction guide for indicating the panning drive direction by the panning drive mechanism, and a tilting direction guide **914** is a tilting direction guide for indicating the tilting drive direction by the tilting drive mechanism. Each of the panning direction guide **913** and the tilting direction guide **914** is represented by a straight line or curve passing through the imaging center **911**. Each of the direction guides **913** and **914** dynamically changes in shape with the changing imaging direction, i.e., according to operations of the panning, tilting, and rotation mechanisms.

As illustrated in FIG. **9**A, the closer the optical axis **901** is to the perpendicular to the panning rotational axis **203**, the straighter the panning direction guide **913** and the smaller its curvature. FIG. **9**B illustrates a display image **920** produced when the tilting mechanism is operated from the state of the optical axis **901** to bring the imaging direction close to the panning rotational axis **203**. As illustrated in FIG. **9**B, the closer the imaging direction is to the panning rotational axis **203**, the shorter the distance between the imaging center **911** and the panning rotation center **912** and the larger the curvature of the panning direction guide **913** on the display image **920**. When the imaging direction is close to the panning rotational axis **203**, the panning direction guide **913** forms a circle or arc having a small radius, making it difficult for the user to recognize the panning drive direction. If the imaging apparatus **110** continues the tilting operation from the above-mentioned state, the panning direction guide **913** converges to a point and can no longer be displayed when the imaging direction coincides with the panning rotational axis **203**. In this state, the user cannot recognize the panning drive direction.

As mentioned above, when the panning direction guide **913** and the tilting direction guide **914** are superimposed onto the captured image such that these direction guides pass through the center of the captured image, it becomes difficult or impossible for the user to recognize the panning moving direction. In this state, the user may be confused when attempting to adjust the orientation of the imaging apparatus **110** with a desired imaging direction.

SUMMARY OF THE INVENTION

The present invention is directed to making it easier for a user to recognize drive directions of an imaging apparatus when attempting to adjust the orientation of the imaging apparatus with a desired imaging direction.

According to an aspect of the present invention, a control apparatus for controlling an imaging apparatus capable of changing an imaging direction of an imaging unit in panning and tilting directions includes an acquisition unit configured to acquire a captured image captured by the imaging unit, and a provision unit configured to provide, together with the captured image, when the imaging direction of the imaging unit coincides with a panning rotational axis for rotating the imaging direction in the panning direction, a panning direction guide for indicating that changing the imaging direction in the panning direction rotates the captured image around an imaging center which is an intersection of an optical axis of the imaging unit and a plane containing the captured image.

According to an exemplary embodiment of the present invention, superimposing a panning direction guide not overlapping an imaging center onto a captured image makes it easier for the user to recognize drive directions of the imaging apparatus.

Further features and aspects of the present invention will become apparent from the following detailed description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate exemplary embodiments, features, and aspects of the invention and, together with the description, serve to explain the principles of the invention.

FIG. **1** is a block diagram illustrating an imaging control system according to first and second exemplary embodiments of the present invention.

FIGS. **2**A and **2**B illustrate an imaging apparatus having panning, tilting, and rotation mechanisms.

FIGS. **3**A to **3**F illustrate display images according to the first exemplary embodiment.

FIG. **4** illustrates a display image produced when an imaging apparatus according to the first exemplary embodiment is driven for rotation.

FIG. **5** is a flow chart illustrating operations of a control apparatus according to the first exemplary embodiment.

FIG. **6** is a flow chart illustrating operations of the imaging apparatus according to the first exemplary embodiment.

FIGS. **7**A and **7**B illustrate a virtual spherical surface around the imaging apparatus.

FIGS. **8**A and **8**B illustrate display images according to the second exemplary embodiment.

FIGS. **9**A and **9**B illustrate an exemplary conventional imaging control system.

FIG. **10** is a block diagram illustrating an imaging control system according to third and fourth exemplary embodiments of the present invention.

FIGS. **11**A to **11**D illustrate display images according the third exemplary embodiment of the present invention.

FIGS. **12**A to **12**C illustrate display images according to the fourth exemplary embodiment of the present invention.

FIGS. **13**A and **13**B illustrate display images produced when an imaging apparatus according to the fourth exemplary embodiment is driven for rotation.

DESCRIPTION OF THE EMBODIMENTS

Various exemplary embodiments, features, and aspects of the invention will be described in detail below with reference to the drawings.

FIG. **1** is a block diagram illustrating an imaging control system according to a first exemplary embodiment of the present invention. Referring to FIG. **1**, an imaging apparatus **110** captures an image. A client apparatus **130** sets up the imaging apparatus **110**, and displays and records the captured image. A network **190** connects the imaging apparatus **110** to the client apparatus **130**. The network **190** includes a plurality of routers, switches, and cables satisfying, for example, Ethernet and other communications standards. The present exemplary embodiment is based on any communication standard, scale, and configuration as long as communications between respective servers and clients are achieved. For example, the network **190** may be composed of any one of the Internet, a wired local area network (LAN), a wireless LAN, and a wide area network (WAN).

A configuration of the imaging apparatus **110** according to the present exemplary embodiment will be described below. An imaging unit **111** includes an image sensor and an optical system for forming a subject image on the image sensor, and is configured to capture the image formed on the image sensor with an intersection of the optical axis of the optical system and the image sensor as an imaging center. The image sensor is a complementary metal-oxide semiconductor (CMOS) sensor or a charge-coupled device (CCD) sensor.

A panning drive unit **112**, a tilting drive unit **113**, and a rotation drive unit **114** drive the imaging unit **111** based on a command from a central processing unit (CPU) **115** (described below). The panning drive unit **112** drives the imaging unit **111** for panning. The tilting drive unit **113** drives the imaging unit **111** for tilting. The rotation drive unit **114** rotates a lens unit **207** (described below) constituting the imaging unit **111**, around a rotational axis for rotation (described below). In the present exemplary embodiment, the rotational axis for rotation coincides with an imaging direction **208** of the imaging unit **111**. The imaging unit **111** may change the imaging direction **208** to the panning, tilting, or rotation direction with manual operation.

A video processing unit **116** processes a video signal captured by the imaging unit **111**. The video signal processing performed by the video processing unit **116** includes converting the video signal captured by the imaging unit **111** into digital form, and coding the digital video signal. The digital video signal format may be, for example, the YUV format. The digital video signal coding method may be based on any one of the MPEG4, H.264, MJPEG, and JPEG standards. The video signal having undergone the video signal processing by the video processing unit **116** is once stored in a memory **117** and then output to the client apparatus **130** via a communication control unit **118** and the network **190**, under control of the CPU **115** (described below).

The communication control unit **118** applies packetization processing to the coded digital video signal. To output the digital video signal to the network **190**, the communication control unit **118** performs packet multiplexing processing based on a predetermined format, under control of the CPU **115**. The predetermined format includes the hypertext transfer protocol (HTTP) and the real-time transport protocol (RTP). The communication control unit **118** transmits to the network **190** the digital video signal captured by the imaging unit **111**.

The CPU **115** loads a program from the memory **117** and then executes it to control operations of each component included in the imaging apparatus **110**. The CPU **115** also controls the panning drive unit **112**, the tilting drive unit **113**, and the rotation drive unit **114** according to commands received from the client apparatus **130** via the network **190**. Based on results of driving the imaging apparatus **110** by the panning drive unit **112**, the tilting drive unit **113**, and the rotation drive unit **114**, the CPU **115** also transmits panning, tilting, and rotation positions of the imaging unit **111** to the client apparatus **130** via the communication control unit **118**. The CPU **115** acquires from the imaging unit **111** a viewing angle (angle of view) of the imaging unit **111** and the size of the captured image captured by the imaging unit **111**, and transmits them to the client apparatus **130**. The size of the image refers to, for example, the length of the diagonal line of the captured image **302**.

An exemplary imaging apparatus **110** is illustrated in FIGS. **2**A and **2**B. FIG. **2**A is a side view of the imaging apparatus **110**. Referring to FIG. **2**A, a rotation unit for panning includes a bottom case **201** and a turntable **202**, which rotates around the panning rotational axis **203**. The panning rotational axis **203** rotates the imaging direction **208** in the panning direction. The panning drive unit **112** includes a stepping motor and is configured to drive the imaging unit **111** for panning by rotating the turntable **202**.

FIG. **2**B is a front view of the imaging apparatus **110**. A rotation unit for tilting includes a lens support **204** and a lens case **206**, and is configured to rotate the lens case **206** around a tilting rotational axis **205**. The tilting drive unit **113** includes a stepping motor and is configured to drive the imaging unit

111 for tilting by rotating the lens case 206. A rotation unit for rotation includes the lens case 206 and the lens unit 207, which rotates around the rotational axis for rotation. The rotation drive unit 114 includes a stepping motor and is configured to drive the imaging unit 111 for rotation by rotating the lens unit 207.

The client apparatus 130 will be described below with reference to FIG. 1. Under control of a CPU 137, the client apparatus 130 receives the captured image transmitted from the imaging apparatus 110 via a communication control unit 131, stores the captured image in a memory 132, and then transmits it to a display control unit 133.

The display control unit 133 superimposes a panning direction guide for indicating the panning drive direction by the panning drive unit 112 onto the captured image captured by the imaging unit 111. The display control unit 133 also superimposes a tilting direction guide for indicating the tilting drive direction by the tilting drive unit 113 onto the captured image captured by the imaging unit 111. Then, the display control unit 133 superimposes onto the captured image a panning direction guide for indicating the panning drive direction by the panning drive unit 112 and a tilting direction guide for indicating the tilting drive direction by the tilting direction guide 113, and displays the resultant image on a display apparatus 170. Display modes will be described below with reference to FIGS. 3A to 3F. Then, the display control unit 133 performs display control for displaying user interfaces such as operation buttons on the display apparatus 170.

A user interface (UI) control unit 136 receives a command from an input apparatus 150 (described below), and transmits to the imaging apparatus 110 commands for controlling the panning drive unit 112, the tilting drive unit 113, and the rotation drive unit 114 via the communication control unit 131, under control of the CPU 137. The UI control unit 136 includes a panning operation unit 138 for operating the panning drive unit 112, a tilting operation unit 139 for operating the tilting drive unit 113, and a rotation operation unit 140 for operating the rotation drive unit 114.

The input apparatus 150 inputs from the user various commands for operating the imaging apparatus 110. The input apparatus 150 outputs to the UI control unit 136 panning, tilting, and rotation drive commands input by the user. The input apparatus 150 is, for example, a keyboard, mouse, etc. The user operates the operation buttons displayed on the display apparatus 170 (described below) by using the keyboard or mouse to operate the imaging apparatus 110. The input apparatus 150 and the display apparatus 170 may be configured as one apparatus, and commands to the imaging apparatus 110 may be input from a touch panel.

Through display control by the display control unit 133, the display apparatus 170 displays the captured image captured by the imaging apparatus 110 and direction guides indicating the panning and tilting drive directions. Although FIG. 1 illustrates the client apparatus 130 and the display apparatus 170 as independent apparatuses, they may be configured as one apparatus. For example, when using a personal computer (PC) as the client apparatus 130, displaying the captured image and direction guides on the display of the PC enables the PC to serve also as the display apparatus 170.

Exemplary display images displayed on the display apparatus 170 through display control by the display control unit 133 are illustrated in FIGS. 3A to 3F. FIG. 3A illustrates a state where the imaging direction 208 is close to the perpendicular to the panning rotational axis 203. Referring to FIG. 3A, a display image 310 is displayed on the display apparatus 170 after the display control unit 133 applies display control to the captured image received from the imaging apparatus 110 by the client apparatus 130. An imaging center 311 is an intersection of the optical axis of the optical system for forming a subject image on the image sensor and a plane containing the captured image captured by the imaging unit 111.

A panning rotation center 312 indicates the position of a panning rotation center in the plane of the display image 310. A panning main guide 313 is a panning direction guide for indicating the panning moving direction such that the panning main guide 313 overlaps a moving path to be traced by the imaging center 311 while the imaging unit 111 is driven for panning. A method for setting the panning rotation center 312 and a method for displaying the panning main guide 313 will be described below with reference to FIG. 3E. A tilting main guide 314 is a tilting direction guide for indicating the tilting moving direction such that the tilting main guide 314 overlaps a moving path to be traced by the imaging center 311 while the imaging unit 111 is driven for tilting. A panning sub guide 315 is a panning direction guide which does not pass through the imaging center 311. In the present exemplary embodiment, the panning sub guide 315 is superimposed onto the captured image such that the panning sub guide 315 does not overlap a moving path to be traced by the imaging center 311 while the imaging unit 111 is driven for panning. The panning sub guide 315 is displayed on the outer side of the panning main guide 313 at a suitable interval from the panning rotation center 312. The panning sub guide 315 shows the user the panning drive direction similarly to the panning main guide 313. Thus, the display control unit 133 superimposes onto the captured image the panning direction guides not passing through the imaging center 311 when the imaging unit 111 is driven for panning. A method for displaying the panning sub guide 315 will be described below.

A method for displaying the panning main guide 313 and a method for setting the panning rotation center 312 will be described below with reference to FIG. 3E. Referring to FIG. 3E, the panning rotational axis 203 is used by the imaging unit 111 for panning rotation, and an imaging apparatus position 300 indicates the position of the imaging apparatus 110. Referring to FIG. 3E, a captured image 302 is virtually arranged so as to perpendicularly intersect with the imaging direction 208 of the imaging unit 111, and a vector 301 indicates the direction of the center of the captured image 302. The magnitude of the vector 301 is set up according to the viewing angle of the captured image 302 and the size of the captured image 302.

The display control unit 133 performs display control for the panning main guide 313 and sets up the panning rotation center 312. The display control unit 133 first calculates the magnitude of the vector 301 based on the viewing angle acquired from the imaging apparatus 110 and the size of the captured image 302. The magnitude of the vector 301 is calculated, for example, by formula (1).

$$L = d/\tan\alpha \quad (1)$$

where L denotes the magnitude of the vector 301, 2d denotes the length of a diagonal line of the captured image 302, and 2α denotes the viewing angle of a diagonal line of the captured image 302.

The display control unit 133 also calculates the value of an angle 303 between the panning rotational axis 203 and the vector 301 based on a tilting angle acquired from the imaging apparatus 110. Then, the display control unit 133 derives the length of a panning rotation radius 304 based on the calculated magnitude L of the vector 301 and the value of the angle 303. The length of the panning rotation radius 304 can be calculated by formula (2).

$$r = L \cdot \sin\beta \quad (2)$$

where r denotes the length of the panning rotation radius **304** and β denotes the value of the angle **303**.

Based on the thus-obtained panning rotation radius **304**, the display control unit **133** calculates the circumference of a circle perpendicularly intersecting with the panning rotational axis **203** as a panning rotational orbit **305**. Then, the display control unit **133** projects the panning rotational orbit **305** (viewed from the imaging apparatus position **300**) from the imaging apparatus position **300** onto the virtual captured image **302** to display the panning main guide **313**.

Then, the display control unit **133** sets up an intersection of a plane containing the captured image **302** and the panning rotational axis **203** as the panning rotation center **312**. In the present exemplary embodiment, when the value of the angle **303** is 90 degrees, the panning rotation center **312** is to be set as a point existing above in FIG. **3**E, on a straight line passing through the imaging center **311** of the captured image **302** and being parallel to the panning rotational axis **203** on the plane containing the captured image **302**. Setting the panning rotation center **312** when the value of the angle **303** is 90 degrees is based not only on the above-mentioned method. When the value of the angle **303** is 90 degrees, the panning rotation center **312** may not to be set on the plane containing the captured image **302**.

Displaying the panning main guide **313** and setting the panning rotation center **312** are based not only on the above-mentioned methods. For example, the panning rotation center **312** is set to a point existing above in FIG. **3**A in the tilting drive direction, where the distance from the imaging center **311** of the display image **310** is equal to the panning rotation radius **304**. An arc around the panning rotation center **312** and having a radius equal to the panning rotation radius **304** may be displayed as the panning main guide **313**. Further, the panning main guide **313** may not be displayed as an arc. For example, as illustrated in FIG. **3**F, the panning main guide **313** may be displayed as arrows to indicate the panning drive direction. For example, arrows may be drawn to be circumscribed on a curve drawn by projecting the panning rotational orbit **305**. Alternatively, arrows may be drawn such that their respective ends are inscribed into a curve drawn by projecting the panning rotational orbit **305**. The above-mentioned methods for displaying the panning drive direction are to be considered as examples for indicating the panning drive direction, and displaying the panning drive direction is based not only thereon. In the above-mentioned examples, although the panning main guide **313** is displayed as a part or the whole of a circle having an equal radius, the panning main guide **313** may be drawn as a part or the whole of an ellipse around the imaging center **311**.

A method for displaying the panning sub guide **315** will be described below. The panning sub guide **315** can be displayed to be constantly distant from the panning main guide **313**. Alternatively, similar to the panning main guide **313**, the panning drive direction may be displayed as arrows inscribed or circumscribed with respect to a curve drawn to be constantly distant from the panning main guide **313**. Although the panning main guide **313** is drawn by a solid line and the panning sub guide **315** is drawn by a dashed line in FIG. **3**A, the panning main guide **313** may be drawn by a dashed line and the panning sub guide **315** may be drawn by a solid line. Displaying the panning sub guide **315** is based not only on the above-mentioned method but also on any other method as long as the method indicates the panning drive direction such that the method does not pass through the imaging center **311** when the imaging unit **111** is driven for panning.

Suppose that, in the state illustrated in FIG. **3**A, the user inputs from the input apparatus **150** a command for driving the imaging unit **111** for tilting, the imaging unit **111** is driven for tilting toward the panning rotation center **312** (in the upward direction in FIG. **3**A), and the imaging direction **208** comes close to the panning rotational axis **203**. A display image **320** displayed in this state will be described below with reference to FIG. **3**B. When the imaging direction **208** comes close to the panning rotational axis **203**, the imaging center **311** and the panning rotation center **312** come close to each other to reduce the radius of the panning main guide **313**, making it difficult for the user to recognize the panning drive direction. However, displaying the panning sub guide **315** on the outer side of the panning main guide **313** enables indicating the panning drive direction with an arc having a larger radius, making it easier for the user to recognize the panning drive direction.

Suppose that, in the state illustrated in FIG. **3**B, the imaging unit **111** is further driven for tilting toward the panning rotation center **312**, and the imaging center **311** coincides with the panning rotational axis **203**. A display image **330** in this state will be described below with reference to FIG. **3**C. In this state, since the position of the panning rotation center **312** derived from state values of the imaging apparatus **110** coincides with the imaging center **311**, the panning main guide **313** converges to a point and can no longer be displayed. However, the panning sub guide **315** set up to be displayed on the outer side of the panning main guide **313** is kept being displayed without converging to a point, enabling the user to recognize the panning drive direction. Thus, the display control unit **133** provides, together with a captured image, a panning direction guide indicating that changing the imaging direction **208** to the panning direction rotates the captured image around the imaging center **311** when the imaging direction **208** of the imaging unit **111** coincides with the panning rotational axis **203**.

Further, like a display image **340** illustrated in FIG. **3**D, the display control unit **133** can display a second panning sub guide **316** on the inner side of the panning main guide **313**. The second panning sub guide **316** can show the user in advance how the panning main guide **313** will change when the imaging unit **111** is driven for tilting toward the panning rotation center **312** (in the upward direction in FIG. **3**D). Therefore, even if the panning main guide **313** converges to a point and can no longer be displayed as mentioned above, the second panning sub guide **316** can suitably inform the user of the moving direction of the captured image without confusing the user. Thus, the imaging control system or the control apparatus according to the present exemplary embodiment can make it easier for the user to recognize the panning drive direction of the imaging apparatus **110**.

Suppose that, in the state illustrated in FIG. **3**D, the imaging unit **111** is driven for rotation. A display image **410** produced in this state is illustrated in FIG. **4**. When the imaging unit **111** is driven for rotation, the display image **340** in FIG. **3**D rotates around the imaging center **311**. With the rotation of the display image **340**, the display control unit **133** rotates the orientation of the panning main guide **313**, the tilting main guide **314**, and the panning sub guides **315** and **316** around the imaging center **311**, and superimposes them onto the captured image. Thus, the display control unit **133** superimposes the panning direction guides and the tilting direction guides on the captured image depending on the amount of rotation drive operation by the rotation drive unit **114**.

Thus, the client apparatus **130** can show the user the panning and tilting drive directions when the imaging unit **111** is driven for rotation. Further, even when the panning rotation center **312** coincides with the imaging center **311** and the

panning main guide **313** converges to a point and can no longer be displayed, the panning sub guide **315** can show the user the panning drive direction. Then, the panning sub guide **316** can show the user in advance how the panning main guide **313** will change when the imaging unit **111** is driven for tilting toward the panning rotation center **312**. When the imaging unit **111** is driven for rotation, the panning and tilting drive directions incline as illustrated in FIG. **4**, making it difficult for the user to grasp the panning and tilting drive directions. However, the present exemplary embodiment can show the user the panning and tilting drive directions even when the optical axis of the imaging apparatus **110** comes close to the panning rotational axis **203**.

Thus, the panning direction guides such as the panning main guide **313** and the panning sub guides **315** and **316** indicate that changing the imaging direction **208** to the panning direction rotates a predetermined point on the captured image around the panning rotation center **312**. Although the panning direction guides indicate a part or the whole of a circle having a constant radius in the above-mentioned examples for convenience, they may indicate a part or the whole of an ellipse around the imaging center **311**.

Operations of the client apparatus **130** according to the present exemplary embodiment will be described below with reference to the flow chart in FIG. **5**. The processing of the flow chart in FIG. **5** is implemented by a program for causing the client apparatus **130** to execute the processing in FIG. **5**. The client apparatus **130** includes a computer (the CPU **137**) for executing a program loaded from the memory **132** included in the client apparatus **130**.

In step S**90**, the communication control unit **131** of the client apparatus **130** acquires the captured image captured by the imaging unit **111**. In step S**100**, the client apparatus **130** enters the panning, tilting, and rotation (PTR) setting mode. The PTR setting mode is a mode which enables the user to set up operations of the panning drive unit **112**, the tilting drive unit **113**, and the rotation drive unit **114** of the imaging apparatus **110** from the client apparatus **130**. More specifically, when the PTR mode is entered, the display control unit **133** displays on the display apparatus **170** the display image **340** and operation buttons for setting panning, tilting, and rotation operations upon reception of a command from the CPU **137**. Then, the client apparatus **130** issues a command to the imaging apparatus **110** according to a command input by the user by operating the operation buttons on the input apparatus **150**.

In step S**110**, the client apparatus **130** displays the panning main guide **313**, the tilting main guide **314**, and the panning sub guides **315** and **316** according to the current panning, tilting, and rotation angles, as illustrated in FIGS. **3**A to **3**F and **4**.

In step S**120**, the client apparatus **130** determines whether a command for driving the imaging apparatus **110** is input from the input apparatus **150**. When a command for driving the imaging apparatus **110** is input from the input apparatus **150** to the client apparatus **130** (YES in step S**120**), the processing proceeds to step S**130**. In step S**130**, the client apparatus **130** transmits to the imaging apparatus **110** a drive command corresponding to an operation input by the user. Then, the processing returns to step S**110**.

Operations of the imaging apparatus **110** according to the present exemplary embodiment will be described below with reference to the flow chart in FIG. **6**. The processing of the flow chart in FIG. **6** is implemented by a program for causing the imaging apparatus **110** to execute the processing illustrated in FIG. **6**. The imaging apparatus **110** includes a computer (the CPU **115**) for executing a program loaded from the memory **117** included in the imaging apparatus **110**.

In step S**200**, the imaging apparatus **110** initializes the imaging apparatus **110**, i.e., the panning drive unit **112**, the tilting drive unit **113**, and the rotation drive unit **114**, as well as the imaging unit **111**. Through initialization, the imaging apparatus **110** confirms origin positions of the panning drive unit **112**, the tilting drive unit **113**, and the rotation drive unit **114**, and detects current imaging positions of these units.

In step S**210**, the imaging apparatus **110** transmits to the client apparatus **130** current positions of the panning drive unit **112**, the tilting drive unit **113**, and the rotation drive unit **114**, as well as the viewing angle of the captured image as a status. Upon completion of initialization, in step S**220**, the imaging apparatus **110** transmits the captured image to the client apparatus **130**. In step S**230**, the imaging apparatus **110** waits for reception of a command from the client apparatus **130**.

When a command is received from the client apparatus **130** (YES in step S**230**), the processing proceeds to step S**240**. In step S**240**, the imaging apparatus **110** drives the imaging unit **111** for panning, tilting, or rotation, or a plurality of drive operations according to the received command. The panning drive unit **112**, the tilting drive unit **113**, and the rotation drive unit **114** drive the imaging unit **111** for panning, tilting, and rotation, respectively. In step S**250**, after the imaging unit **111** is driven as specified by the client apparatus **130**, the imaging apparatus **110** transmits to the client apparatus **130** current positions of the panning drive unit **112**, the tilting drive unit **113**, and the rotation drive unit **114**, as well as the viewing angle of the captured image as a status. Then, the processing returns to step S**230** to wait for command reception.

Although the panning sub guides **315** and **316** are constantly displayed on the outer and inner sides of the panning main guide **313**, respectively, the timing of displaying the panning sub guides **315** and **316** is not limited to thereto. The panning sub guides **315** and **316** may be displayed only when the imaging area of the imaging unit **111** falls within a specific range. For example, when the value of the angle **303** between the panning rotational axis **203** used by the panning drive unit **112** to drive the imaging unit **111** for panning and the vector **301** of the imaging unit **111** is equal to or less than a threshold value, the display control unit **133** can superimpose the panning sub guides **315** and **316** onto the captured image. In this case, the vector **301** coincides with the optical axis of the imaging unit **111**. Alternatively, when the distance between the imaging center **311** and the panning rotation center **312** illustrated in FIG. **3**A is equal to or less than a predetermined value, the panning sub guides **315** and **316** can be displayed.

As mentioned above, the distance between the imaging center **311** and the panning rotation center **312** is determined by the length of the panning rotation radius **304** illustrated in FIG. **3**E. The length of the panning rotation radius **304** depends on the viewing angle of the imaging unit **111** and the size of the captured image **302**. Therefore, changing the threshold value of the angle **303** according to the viewing angle of the imaging unit **111** and the size of the captured image enables the display control unit **133** to display the panning sub guides **315** and **316** when the distance between the imaging center **311** and the panning rotation center **312** is equal to or less than the predetermined value. Determining whether the imaging area of the imaging unit **111** falls within a specific range is based not only on the above-mentioned method but also on any other method.

Processing is based not only on the above-mentioned modes. The panning sub guide **315** may indicate that changing the imaging direction **208** to the panning direction rotates the captured image around the imaging center **311** when the imaging direction **208** of the imaging unit **111** coincides with

the panning rotational axis **203**. A case where the imaging direction **208** of the imaging unit **111** coincides with the panning rotational axis **203** is not limited to a case where they actually coincide with each other. For example, such cases include a case where, even when the panning main guide **313** is displayed, the user cannot recognize that changing the imaging direction **208** to the panning direction rotates the captured image since the angle between the imaging direction **208** of the imaging unit **111** and the panning rotational axis **203** is equal to or less than a threshold value. Such cases include a case where the panning main guide **313** cannot be displayed since the angle between the imaging direction **208** of the imaging unit **111** and the panning rotational axis **203** is equal to or less than the threshold value. The threshold value can be arbitrarily set, for example, to 5 degrees.

When the imaging direction **208** of the imaging unit **111** coincides with the panning rotational axis **203**, processing is not limited to superimposition of the panning sub guide **315** onto the captured image as illustrated in FIG. **3**C, but a part or the whole of a circle may be displayed around the captured image. Thus, it becomes possible to indicate that the captured image will rotate around the imaging center **311**.

When the imaging direction **208** of the imaging unit **111** coincides with the panning rotational axis **203**, a text message may be displayed on the display screen to notify the user that changing the imaging direction **208** to the panning direction rotates the captured image, instead of displaying the panning sub guide **315** as illustrated in FIG. **3**C. In this case, a text message such as "changing the imaging direction to the panning direction rotates the screen" may be displayed together with the captured image. Alternatively, when the imaging direction **208** of the imaging unit **111** coincides with the panning rotational axis **203**, a text message may be displayed on the display screen to enable the user to recognize the direction of screen rotation accompanying the panning operation. In this case, a text message such as "panning to the right rotates the screen counterclockwise" or "panning to the left rotates the screen clockwise" may be displayed together with the captured image.

When the imaging direction **208** of the imaging unit **111** coincides with the panning rotational axis **203**, an audio message may be generated to notify the user that changing the imaging direction **208** to the panning direction rotates the captured image around the imaging center **311**. For example, when the imaging direction **208** of the imaging unit **111** coincides with the panning rotational axis **203**, an audio guidance such as "the captured image will rotate" may be provided when panning operation is made. Similar to displaying the above-mentioned text messages, an audio message may notify the user of the direction of screen rotation accompanying the panning operation.

Thus, even after the panning main guide **313** is no longer displayed, the panning sub guide **315** can notify the user of the panning drive direction. Further, when the panning main guide **313** is highly likely to converge to the panning rotation center **312** when the imaging unit **111** is driven for tilting, the panning sub guide **316** may be displayed on the inner side of the moving path of the imaging center **311** (on the side of the panning rotation center **312**) to notify the user that continuing the tilting drive operation causes the panning main guide **313** to be hidden by the panning sub guide **316**. Then, hiding the panning sub guides **315** and **316** when the imaging area of the imaging unit **111** is not within a specific range enables giving priority to the viewability of the captured image. The user may not only use a threshold value but also display and hide the panning sub guides **315** and **316**. In the present exemplary embodiment, displaying the panning and tilting moving directions is based not only on the above-mentioned method.

According to the above-mentioned configuration, the display control unit **133** superimposes onto the captured image a panning direction guide not overlapping a moving path to be traced by the imaging center **311** while the imaging unit **111** is driven for panning. Therefore, the user can recognize the moving direction even when the imaging center **311** overlaps the panning rotation center **312** and the panning main guide **313** is no longer displayed. Further, displaying the panning sub guide **316** on the inner side of the moving path of the imaging center **311** (on the side of the panning rotation center **312**) enables the user to recognize how the panning main guide **313** changes before the imaging center **311** overlaps the panning rotation center **312**. Thus, the present exemplary embodiment can suitably notify the user of the moving direction of the imaging area. Therefore, the user can recognize the panning drive direction of the imaging apparatus **110** more easily than in a case where only the panning main guide **313** is displayed on a display image.

Although the present exemplary embodiment displays the panning main guide **313** indicating the panning moving direction such that the panning main guide **313** overlaps a moving path to be traced by the imaging center **311**, the effect of the present invention can be achieved even by displaying only the panning sub guides **315** and **316** without displaying the panning main guide **313**.

A second exemplary embodiment of the present invention will be described below focusing on an imaging control system for superimposing onto the captured image the latitude and meridian lines on a spherical surface virtually set up around the imaging apparatus **110**.

A configuration of the imaging control system according to the second exemplary embodiment will be described below. In addition to the panning main guide **313** and the tilting main guide **314**, the display control unit **133** of the client apparatus **130** superimposes onto the captured image the latitude and meridian lines on the spherical surface virtually set up around the imaging apparatus **110**. Other elements are similar to those of the imaging control system according to the first exemplary embodiment illustrated in FIG. **1**, and duplicated explanation will be omitted. Elements similar to those in the first exemplary embodiment illustrated in FIG. **1** are assigned the same reference numerals.

Display images displayed on the display apparatus **170** through display control by the display control unit **133** will be described below with reference to FIGS. **7**A, **7**B, **8**A, and **8**B. FIG. **7**A illustrates a virtual spherical surface virtually set up around the imaging apparatus **110**. Referring to FIG. **7**A, an imaging apparatus position **710** indicates a position at which the imaging apparatus **110** is installed. The panning rotational axis **203** is used to drive the imaging unit **111** for panning. A spherical surface **720** is virtually set up around the imaging apparatus **110**. The spherical surface **720** is provided with latitude lines **721** and meridian lines **722** at predetermined positions thereon. In the present exemplary embodiment, the latitude lines **721** are set up at fixed intervals from the equatorial plane around the imaging apparatus position **710**. The meridian lines **722** are set up at fixed intervals from a predetermined reference meridian line around the imaging apparatus position **710**. Setting the latitude lines **721** and the meridian lines **722** is based not only on the above-mentioned method.

Exemplary display images displayed on the display apparatus **170** when the imaging apparatus **110** captures an image at the imaging apparatus position **710** will be described below with reference to FIGS. **8**A and **8**B. The imaging apparatus

110 transmits the captured image captured thereby to the client apparatus 130. Then, the display control unit 133 superimposes as panning direction guides the latitude lines 721 onto the captured image arranged on the virtual spherical surface 720. In the present exemplary embodiment, the display control unit 133 superimposes a panning main guide 813, the tilting main guide 814, and the meridian lines 722 onto the captured image, and then outputs the resultant image to the display apparatus 170.

Referring to FIG. 8A, a display image 810 is displayed on the display apparatus 170. An imaging center 811 is an intersection of the optical axis of the optical system for forming a subject image on the image sensor and a plane containing the captured image 810 captured by the imaging unit 111. A panning rotation center 812 denotes the position of a panning rotation center in a plane containing the captured image 810.

The panning main guide 813 is a panning direction guide for indicating the panning moving direction such that the panning main guide 813 overlaps a moving path to be traced by the imaging center 811 while the imaging unit 111 is driven for panning. The tilting main guide 814 passes through the imaging center 811 to indicate the tilting drive direction. The latitude lines 721 and the meridian lines 722 are set up on the spherical surface 720. In the present exemplary embodiment, the panning main guide 813 and the tilting main guide 814 are superimposed onto the captured image 810, and then the latitude lines 721 and the meridian lines 722 are superimposed thereon to auxiliarily indicate the panning and tilting drive directions. The present exemplary embodiment controls display positions of the latitude lines 721 and the meridian lines 722 by using setting values of the latitude lines 721 and the meridian lines 722 set up on the spherical surface 720, and the imaging position of the imaging apparatus 110.

A method for displaying the panning main guide 813 is similar to the relevant method in the first exemplary embodiment illustrated in FIG. 3E, and duplicated explanation will be omitted. A method for displaying the latitude lines 721 and the meridian lines 722 will be described below. Based on imaging position information (panning angle, tilting angle, amount of rotation, etc.), the viewing angle, and the image size received from the imaging apparatus 110, the display control unit 133 of the client apparatus 130 sets up a virtual display image 730 on a virtual spherical surface 720, as illustrated in FIG. 7B. Then, the display control unit 133 projects preset latitude lines 721 and meridian lines 722 onto the display image 730 from the imaging apparatus position 710. Thus, the latitude lines 721 and the meridian lines 722 projected onto the display image 730 are displayed as the latitude lines 721 and the meridian lines 722 on the display image 810.

The above-mentioned method is to be considered as an example, and displaying the latitude lines 721 and the meridian lines 722 is based not only thereon. Although the latitude lines 721 and the meridian lines 722 are drawn by dashed lines in FIG. 8A, they may be drawn by solid lines or arrows. Alternatively, the latitude lines 721, the meridian lines 722, the panning main guide 813, and the tilting main guide 814 may be displayed in different colors for distinction.

Suppose that, in the state illustrated in FIG. 8A, the imaging unit 111 is driven for tilting and the imaging direction 208 of the imaging unit 111 coincides with the panning rotational axis 203. A display image 820 in this state will be described below with reference to FIG. 8B. In this state, similar to the first exemplary embodiment, the panning main guide 813 converges to a point and can no longer be displayed. However, the latitude lines 721 set up on the spherical surface 720 auxiliarily indicates the panning drive direction, enabling the user to recognize the panning drive direction. Further, the latitude lines 721 enable the user to confirm in advance how the panning main guide 813 will change when the imaging unit 111 is driven for panning. Thus, the latitude lines 721 in the present exemplary embodiment play the roles of the panning sub guides 315 and 316 in the first exemplary embodiment.

Although the above-mentioned latitude lines 721 and the meridian lines 722 may be constantly displayed similar to the first exemplary embodiment, displaying these lines is based not only on the above-mentioned method. The latitude lines 721 and the meridian lines 722 may be displayed only when the imaging direction 208 falls within a specific range specified by a separately set threshold value, or set up to be displayed or hidden by the user. Further, the latitude lines 721 and meridian lines 722 may be set to variable positions on the spherical surface 720.

When the imaging unit 111 is subsequently driven for rotation, the display image 810 in FIG. 8A rotates around the imaging center 811 similar to the first exemplary embodiment. With the rotation of the captured image 810, the display control unit 133 rotates the orientation of the panning main guide 813 and the tilting main guide 814 around the imaging center 811. Then, the display control unit 133 newly sets up the display image 730 on the spherical surface 720 depending on the amount of rotation drive operation by the rotation drive unit 114. Then, the display control unit 133 projects the latitude lines 721 and the meridian lines 722 after rotation onto the display image 730, and displays the projected latitude lines 721 and the meridian lines 722 on the display image 730 after rotation. Alternatively, together with the panning main guide 813 and the tilting main guide 814, the latitude lines 721 and the meridian lines 722 may be rotated around the imaging center 811 of the display image 810.

Thus, the client apparatus 130 can show the user the panning and tilting drive directions when the imaging unit 111 is driven for rotation. Further, even when the panning rotation center 812 coincides with the imaging center 811 and the panning main guide 813 converges to a point and can no longer be displayed, the latitude lines 721 can show the user the panning drive direction. Then, the latitude lines 721 can show the user in advance how the panning main guide 813 will change when the imaging unit 111 is driven for tilting toward the panning rotation center 812 (in the upward direction in FIG. 8A).

Operations of the client apparatus 130 and the imaging apparatus 110 in the imaging control system according to the present exemplary embodiment are similar to those in the first exemplary embodiment illustrated in FIGS. 5 and 6, and duplicated explanation will be omitted.

With the above-mentioned configuration, the latitude lines 721 are set up on the virtual spherical surface 720 set up around the imaging apparatus 110, and the latitude lines 721 are superimposed onto the display image 810. Therefore, even when the imaging center 811 overlaps the panning rotation center 812 and the panning main guide 813 is no longer displayed, the latitude lines 721 enable the user to recognize the moving direction. The latitude lines 721 also enable the user to recognize how the panning main guide 813 will change before the imaging center 811 overlaps the panning rotation center 812. Thus, the present exemplary embodiment can suitable notify the user of the moving direction of the imaging area. Therefore, the user can recognize the panning drive direction of the imaging apparatus 110 more easily than the case where only the panning main guide 813 is displayed on the display image 810.

Although the present exemplary embodiment displays the panning main guide **813** indicating the panning moving direction such that the panning main guide **813** overlaps a moving path to be traced by the imaging center **811**, the effect of the present invention can be achieved even by displaying only the latitude lines **721** without displaying the panning main guide **813**.

A third exemplary embodiment of the present invention will be described below based on a case where an icon is displayed on the panning main guide **313** or the panning sub guide **315**. This icon is used to input a command for changing the imaging direction **208** to the panning direction.

A configuration of the imaging control system according to the present exemplary embodiment is illustrated in FIG. **10**. Elements similar to those in the first exemplary embodiment illustrated in FIG. **1** are assigned the same reference numerals, and duplicated explanation will be omitted.

In the present exemplary embodiment, the display control unit **133** of the client apparatus **130** superimposes the above-mentioned icon for inputting a command to the panning operation unit **138** onto a position indicating the panning drive direction on the captured image captured by the imaging unit **111**. Lines indicating the panning drive direction refer, for example, to the panning main guide **313** and the panning sub guide **315** illustrated in FIGS. **3**A to **3**F. In the present exemplary embodiment, the panning sub guide **315** indicates that a point existing on a straight line passing through the panning rotation center **312** and the imaging center **311**, where the distance thereof from the panning rotation center **312** is longer than the distance from the panning rotation center **312** to the imaging center **311**, will rotate around the panning rotation center **312**. In this case, the panning main guide **313** or the panning sub guide **315** does not need to be actually superimposed onto the captured image. The icon is preferably superimposed onto a position where the panning main guide **313** or the panning sub guide **315** should be superimposed.

In the present exemplary embodiment, the user interface control unit **136** includes a generation unit **141** for generating panning operation icons (hereinafter referred to as panning operation buttons) for inputting commands to the panning operation unit **138**, and tilting operation icons (hereinafter referred to as tilting operation buttons) for inputting commands to the tilting operation unit **139**. The CPU **137** loads an icon display program from the memory **132** and executes it to control the generation unit **141** to generate these icons. Then, the UI control unit **136** further includes a pointer unit **142** for instructing the display control unit **133** to display a pointer on the display apparatus **170**, according to a command from the input apparatus **150** (described below) such as a mouse.

When the UI control unit **136** detects that the user clicks the mouse on a panning operation button displayed on the display apparatus **170**, the panning operation unit **138** transmits a relevant command for controlling the panning drive unit **112** to the imaging apparatus **110**. Then, when the UI control unit **136** detects that the user clicks the mouse on a tilting operation button displayed on the display apparatus **170**, the tilting operation unit **139** transmits a relevant command for controlling the tilting drive unit **113** to the imaging apparatus **110**. The user clicks on each operation button by using the input apparatus **150**. The operation of each operation button is not limited to mouse operation using the pointer. The user may operate each operation button by touching it on a touch panel. Operating the operation buttons is based not only on the above-mentioned method but also on any other method as long as the user can input commands to the panning operation unit **138** by using the operation buttons. The panning and tilting operation buttons are superimposed onto positions indicating the panning and tilting drive directions, respectively, on the captured image. Displaying these operation buttons in this way enables the user to perform panning and tilting drive operations in a more intuitive way.

FIGS. **11**A to **11**D illustrate exemplary display images displayed on the display apparatus **170** through display control by the display control unit **133**. FIG. **11**A illustrates a display image **1110** produced when the imaging direction **208** is close to the perpendicular to the panning rotational axis **203**. Referring to FIG. **11**A, the display image **1110** is displayed on the display apparatus **170** after the display control unit **133** applies display control to the captured image received from the imaging apparatus **110** by the client apparatus **130**.

The display control unit **133** displays panning operation buttons **317** and tilting operation buttons **318** on the display image **1110**. The panning operation buttons **317** are icons used by the user to drive the imaging unit **111** in the panning direction. In the state illustrated in FIG. **11**A, the panning operation buttons **317** are displayed at both ends of the panning main guide **313**. The tilting operation buttons **318** are icons used by the user to drive the imaging unit **111** in the tilting direction. In the state illustrated in FIG. **11**A, the tilting operation buttons **318** are displayed at both ends of the tilting direction guide **314**. Of the two panning operation buttons **317**, the right-hand side panning operation button **317** is an icon for instructing the panning drive operation in the rightward direction, and the left-hand side panning operation button **317** is an icon for instructing the panning drive operation in the leftward direction. Of the two tilting operation buttons **318**, the top tilting operation button **318** is an icon for instructing the tilting drive operation in the upward direction, and the bottom tilting operation button **318** is an icon for instructing the tilting drive operation in the downward direction. Displaying the panning operation buttons **317** on the panning direction guide **313** and the tilting operation buttons **318** on the tilting direction guide **314** enables the user to recognize the drive direction and perform panning and tilting drive operations in a more intuitive way.

Suppose that, in the state illustrated in FIG. **11**A, the user instructs from the input apparatus **150** to drive the imaging unit **111** for tilting, the imaging unit **111** is driven for tilting toward the panning rotation center **312** (in the upward direction in FIG. **11**A), and the imaging direction **208** comes close to the panning rotational axis **203**. A display image **1120** in this state will be described below with reference to FIG. **11**B.

When the imaging direction **208** comes close to the panning rotational axis **203**, the one panning operation button **317** displayed at one end of the panning main guide **313** overlaps the other panning operation button **317** displayed at the other end of the panning main guide **313**. However, when display positions of the panning operation buttons **317** are changed to both ends of the panning sub guide **315**, the one panning operation button **317** does not overlap the other panning operation button **317**. Specifically, when an angle between the panning rotational axis **203** and the optical axis of the imaging unit **111** is greater than a predetermined threshold value, the display control unit **133** displays the panning operation buttons **317** on the panning main guide **313**. When the angle between the panning rotational axis **203** and the optical axis of the imaging unit **111** becomes equal to or less than the predetermined threshold value, the display control unit **133** changes display positions of the panning operation buttons **317**. A method for setting the threshold value will be described below. Thus, the display control unit **133** superimposes the panning operation buttons **317** onto

positions where the distance from the panning rotation center **312** to the panning operation buttons **317** is longer than the distance from the panning rotation center **312** to the imaging center **311** on the captured image.

A method for determining the threshold value will be described below. For example, the value of the angle **303** with which the distance from the panning rotation center **312** to the imaging center **311** is a quarter of the length of the tilting direction guide **314** displayed on the display image **1110** can be set as the threshold value. Specifically, when a circle around the panning rotation center **312** and having a radius equal to the distance between the imaging center **311** and the panning rotation center **312** is entirely contained in the display image **1110**, display positions of the panning operation buttons **317** may be changed.

Referring to FIG. **3**E, when the panning rotation center **312** is an intersection of a plane containing the captured image **302** and the panning rotational axis **203**, a distance x between the imaging center **311** and the panning rotation center **312** is represented by formula (3).

$$x = L \cdot \tan\beta \tag{3}$$

where L denotes the magnitude of the vector **301** and β denotes the value of the angle **303**.

Therefore, an angle β with which the value of L·tanβ is smaller than a quarter of the length of the tilting direction guide **314** displayed on the display image **1110** can be set as the threshold value of the angle **303**. Setting the threshold value is based not only on the above-mentioned method but may be based on other methods. For example, an angle β with which the distance x is equal to or less than a total sum of a quarter of the length of the tilting direction guide **314** displayed on the display image **1110** and a distance between the panning main guide **313** and the panning sub guide **315** displayed thereon can be set as the threshold value of the angle **303**.

The above-mentioned method can prevent the one panning operation button **317** displayed at one end of the panning direction guide **313** from overlapping the other panning operation button **317** displayed at the other end of the panning direction guide **313**.

Suppose that, in the state illustrated in FIG. **11**B, the imaging unit **111** is further driven for tilting toward the panning rotation center **312**, and the imaging center **311** coincides with the panning rotational axis **203**. A display image **1130** in this state will be described below with reference to FIG. **11**C. In this state, since the position of the panning rotation center **312** derived from state values of the imaging apparatus **110** coincides with the imaging center **311**, the panning main guide **313** converges to a point and can no longer be displayed. However, the panning sub guide **315** set up to be displayed on the outer side of the panning main guide **313** is kept being displayed without converging to a point, enabling the user to recognize the panning drive direction. When the imaging center **311** coincides with the panning rotational axis **203**, the panning operation buttons **317** set to be displayed at both ends of the panning main guide **313** are no longer displayed on the display image **1130**. However, displaying the panning operation buttons **317** at both ends of the panning sub guide **315** prevents the panning operation buttons **317** from being hidden as the imaging unit **111** is driven for tilting. Thus, the display control unit **133** displays the panning operation buttons **317** on the panning direction guide **315** indicating that changing the imaging direction **208** to the panning direction rotates the captured image around the imaging center **311**.

In the present exemplary embodiment, with the rotation of a display image **1140**, the display control unit **133** rotates display positions of the panning operation buttons **317** and the tilting operation buttons **318** around the imaging center **311** and then superimposes these operation buttons onto the captured image, as illustrated in FIG. **11**D. Specifically, the panning operation buttons **317** are displayed at both ends of the panning direction guide **313** on the rotated captured image **410** illustrated in FIG. **4**. Further, the tilting operation buttons **318** are displayed at both ends of the tilting direction guide **314** in the rotated captured image **410** illustrated in FIG. **4**. Thus, the client apparatus **130** can display the panning operation buttons **317** and the tilting operation buttons **318** in the panning and tilting directions, respectively, on the captured image produced when the imaging unit **111** is driven for rotation. Further, even when the panning rotation center **312** coincides with the imaging center **311**, and the panning main guide **313** converges to a point and can no longer be displayed, the panning sub guide **315** can show the user the panning drive direction. Further, even when the panning rotation center **312** coincides with the imaging center **311**, and the panning main guide **313** converges to a point and can no longer be displayed, displaying the panning operation buttons **317** on the panning sub guide **315** enables the user to use the panning operation buttons **317**.

Operations of the client apparatus **130** and the imaging apparatus **110** in the imaging control system according to the present exemplary embodiment will be described below. In the present exemplary embodiment, in step S**110** illustrated in FIG. **5**, the client apparatus **130** displays the panning operation buttons **317** on the panning main guide **313** or the panning sub guides **315** and **316** as mentioned above. Other operations of the client apparatus **130** and the imaging apparatus **110** according to the present exemplary embodiment are similar to those in the first exemplary embodiment illustrated in FIGS. **5** and **6**, and duplicated explanation will be omitted.

According to the above-mentioned configuration, the display control unit **133** superimposes the panning operation buttons **317** onto a panning direction guide not overlapping a moving path to be traced by the imaging center **311** while the imaging unit **111** is driven for panning. Thus, the imaging control system according to the present exemplary embodiment can suitably display the panning operation icons even when the optical axis of the imaging apparatus **110** comes close to the panning rotational axis **203**. Therefore, even when the imaging center **311** overlaps the panning rotation center **312** and the panning main guide **313** is no longer displayed, the user can drive the imaging unit **111** for panning by using the panning operation buttons **317**.

Although, in the present exemplary embodiment, the display control unit **133** changes display positions of the panning operation buttons **317** when the value of the angle **303** between the panning rotational axis **203** and the optical axis of the imaging unit **111** is equal to or less than a predetermined threshold value, the display positions of the panning operation buttons **317** may remain unchanged. Specifically, the panning operation buttons **317** may be displayed on the panning sub guide **315** illustrated in FIGS. **11**A to **11**D regardless of the value of the angle **303**.

Although the present exemplary embodiment displays the panning main guide **313** and the panning sub guides **315** and **316**, only the panning operation buttons **317** may be displayed without displaying the panning main guide **313** and the panning sub guides **315** and **316**. When only the panning operation buttons **317** are displayed, some arrangements may be made to make it easier for the user to recognize the panning drive direction. Specifically, arrows may be drawn on the

panning operation buttons **317** to indicate the panning drive direction or triangular panning operation buttons **317** may be displayed to indicate the panning drive direction with their apexes. Thus, the user can recognize the panning drive direction in a display image and perform a panning drive operation in an intuitive way.

A fourth exemplary embodiment of the present invention will be described below. The present exemplary embodiment displays panning operation buttons at predetermined positions which are symmetrical with respect to a straight line passing through an imaging center and indicating the tilting direction on a display image.

An imaging control system according to the fourth exemplary embodiment is implemented with elements similar to those of the imaging control system according to the third exemplary embodiment illustrated in FIG. **10**, and duplicated explanation will be omitted. Elements similar to those in the first exemplary embodiment illustrated in FIG. **10** are assigned the same reference numerals.

In the fourth exemplary embodiment, a display image **1210** displayed on the display apparatus **170** through display control by the display control unit **133** will be described below with reference to FIGS. **12**A to **12**C. FIG. **12**A illustrates the display image **1210** produced when the imaging direction **208** is close to the perpendicular to the panning rotational axis **203**. An imaging center **1211** is an intersection of the optical axis of the optical system for forming a subject image on the image sensor and a plane containing the captured image captured by the imaging unit **111**. A panning rotation center **1212** indicates the position of a panning rotation center in a plane containing the display image **1210**. A method for setting the panning rotation center **1212** is similar to the relevant method in the first exemplary embodiment illustrated in FIG. **3**E, and duplicated explanation will be omitted.

Referring to FIGS. **12**A to **12**C, a panning main guide **1213** is a panning direction guide for indicating the panning direction on the display image **1210**. The panning main guide **1213** is displayed as a circle or arc around the panning rotation center **1212** passing through panning operation buttons **1217** or as a straight line passing therethrough. In the present exemplary embodiment, the panning main guide **1213** is superimposed onto the captured image such that the panning main guide **1213** does not pass through the imaging center **1211** and the distance from the panning rotation center **1212** to the panning main guide **1213** is longer than the distance from the panning rotation center **1212** to the imaging center **1211**. In the present exemplary embodiment, the panning main guide **1213** indicates that a predetermined point existing on a straight line passing through the panning rotation center **1212** and the imaging center **1211**, where the distance from the panning rotation center **1212** is longer than the distance thereof from the panning rotation center **1212** to the imaging center **1211**, will rotate around the panning rotation center **1212**. A tilting main guide **1214** is a tilting direction guide for indicating the tilting moving direction such that the tilting main guide **1214** overlaps a moving path to be traced by the imaging center **1211** while the imaging unit **111** is driven for tilting.

Then, the display control unit **133** superimposes the panning operation buttons **1217** and tilting operation buttons **1218** onto the display image **1210**. The panning operation buttons **1217** are icons used for inputting commands to the panning operation unit **138**. In the state illustrated in FIG. **12**A, the panning operation buttons **1217** are superimposed onto predetermined positions on the display image **1210**. The tilting operation buttons **1218** are icons for inputting commands to the tilting operation unit **139**. In the state illustrated in FIG. **3**A, the tilting operation buttons **1218** are displayed at both ends of the tilting main guide **1214**.

Display positions of the panning operation buttons **1217** on the display image **1210** will be described below. The two panning operation buttons **1217** illustrated in FIG. **12**A are displayed line-symmetrically with respect to the tilting main guide **1214** to be equally distant from the panning rotation center **1212**. Thus, the two panning operation buttons **1217** are equally distant from any point on the straight line of the tilting main guide **1214**. Therefore, the two panning operation buttons **1217** can be displayed on a circle around the panning rotation center **1212** existing on the straight line of the tilting main guide **1214**. Then, the distance from the panning rotation center **1212** to the panning operation buttons **1217** is set up to be longer than the distance from the panning rotation center **1212** to the imaging center **1211**.

Suppose that, in the state illustrated in FIG. **12**A, the user instructs the input apparatus **150** to drive the imaging unit **111** for tilting, the imaging unit **111** is driven for tilting toward the panning rotation center **1212** (in the upward direction in FIG. **12**A), and the imaging direction **208** comes close to the panning rotational axis **203**. The display image **1210** in this state will be described below with reference to FIG. **12**B. As the imaging direction **208** comes close to the panning rotational axis **203**, the imaging center **1211** and the panning rotation center **1212** come close to each other. On the other hand, since display positions of the panning operation buttons **1217** remain unchanged after the tilting drive operation is made, the panning main guide **1213** maintains a suitable radius without degrading visibility. Suppose that, in the state illustrated in FIG. **12**B, the imaging unit **111** is further driven for tilting toward the panning rotation center **1212** and then the imaging direction **208** coincides with the panning rotational axis **203**. The display image **1210** in this state is illustrated in FIG. **12**C. In this state, the panning rotation center **1212** derived from state values of the network camera coincides with the imaging center **1211**. Since display positions of the panning operation buttons **1217** remain unchanged in this state, the panning main guide **1213** maintains at least a certain fixed radius, enabling an operator to confirm the drive direction and operate the panning operation buttons **1217**.

FIGS. **13**A and **13**B illustrate exemplary display images produced when the rotation mechanism is driven. FIG. **13**A illustrates a display image **1310** produced when the rotation mechanism is driven when the imaging direction **208** is close to the perpendicular to the panning rotational axis **203**. The display control unit **133** performs display control so that the panning operation buttons **1217** and the tilting operation buttons **1218** are rotated with the drive operation of the rotation mechanism. The panning main guide **1213** and the tilting main guide **1214** are also rotated accordingly. Suppose that, in the state illustrated in FIG. **13**A, the imaging unit **111** is driven for tilting toward the panning rotational center **1212** and the imaging direction **208** coincides with the panning rotational axis **203**. A display image **1320** in this state is illustrated in FIG. **13**B. In this state, since display positions of the panning operation buttons **1217** remain unchanged after the tilting operation is made, the panning main guide **1213** maintains a certain fixed radius, enabling the operator to operate each mechanism by using the operation buttons without degrading visibility. Thus, even when the optical axis of the imaging apparatus **110** comes close to the panning rotational axis **203**, the imaging control system according to the present exemplary embodiment can suitably display the panning operation icons.

Operations of the imaging control system according to the present exemplary embodiment are similar to those of the

imaging control system illustrated in FIGS. **5** and **6**, and duplicated explanation will be omitted.

The imaging control system according to the fourth exemplary embodiment displays the panning operation buttons **1217** at predetermined positions on the display image **1310** or **1320** such that the distance from the panning rotational center **1212** to the panning operation buttons **1217** is longer than the distance from the panning rotation center **1212** to the imaging center **1211** while the imaging unit **111** is driven for panning and tilting. With the imaging control system according to the fourth exemplary embodiment, the panning main guide **1213** is superimposed onto the captured image such that the panning main guide **1213** constantly passes through the panning operation buttons **1217**. Therefore, even when the optical axis of the imaging apparatus **110** comes close to the panning rotational axis **203**, the panning operation icons can be displayed.

The first to fourth exemplary embodiments have been specifically described based on a case where the imaging apparatus **110** is provided with the rotation mechanism. In a case where the imaging apparatus **110** is not provided with the rotation mechanism, virtual rotation can be performed by rotating the image on the client apparatus **130**. The present invention can be implemented even with such a configuration. Even in this case, similar to a case where the imaging unit **111** is driven for rotation, the imaging apparatus **110** can show the user the panning and tilting drive directions even when the optical axis of the imaging apparatus **110** comes close to the panning rotational axis **203**.

Although the first to fourth exemplary embodiments display a tilting main guide in addition to a panning main guide and panning sub guides, only the panning sub guides may be displayed. Even when only the panning sub guides are displayed, the first to fourth exemplary embodiments can suitably show the user the moving direction of the imaging area without losing a panning direction guide when the imaging unit **111** is driven for tilting. The client apparatus **130** described in the first to fourth exemplary embodiments may be integrated with the imaging apparatus **110**. Specifically, the present invention can be implemented even after the client apparatus **130** superimposes the panning main guide **313** and the panning sub guide **315** onto the captured image captured by the imaging apparatus **110** and then transmits a display image to the display apparatus **170** via the network **190**.

Aspects of the present invention can also be realized by a computer of a system or apparatus (or devices such as a CPU or MPU) that reads out and executes a program recorded on a memory device to perform the functions of the above-described embodiment (s), and by a method, the steps of which are performed by a computer of a system or apparatus by, for example, reading out and executing a program recorded on a memory device to perform the functions of the above-described embodiment(s). For this purpose, the program is provided to the computer for example via a network or from a recording medium of various types serving as the memory device (e.g., computer-readable medium).

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all modifications, equivalent structures, and functions.

This application claims priority from Japanese Patent Applications No. 2010-197840 filed Sep. 3, 2010 and No. 2010-198775 filed Sep. 6, 2010, which are hereby incorporated by reference herein in their entirety.

What is claimed is:

1. A control apparatus for controlling an imaging apparatus capable of changing an imaging direction of an imaging unit in panning and tilting directions, the control apparatus comprising:

an acquisition unit configured to acquire a captured image captured by the imaging unit; and

a display control unit configured to control to display, on the captured image, if an imaging direction of the imaging unit does not correspond to a panning rotational axis for rotating the imaging unit in the panning direction, a first panning direction guide for indicating that the imaging direction changes along a circle around a rotation center by panning the imaging unit, and to control to display, on the captured image, if the imaging direction of the imaging unit corresponds to the panning rotational axis, a second panning direction guide for indicating that the imaging unit rotates around an imaging center which is an intersection of an optical axis of the imaging unit and a plane containing the captured image by panning the imaging unit.

2. The control apparatus according to claim **1**, further comprising:

a panning operation unit configured to instruct the imaging apparatus to change the imaging direction in the panning direction; and

a display control unit configured to display on the panning direction guide an icon for inputting a command to the panning operation unit.

3. The control apparatus according to claim **2**, wherein the display control unit superimposes a plurality of the icons at predetermined positions on the captured image which are symmetrical with respect to a straight line passing through the imaging center and indicating the tilting direction, and superimposes on the captured image the panning direction guide passing through the icons.

4. The control apparatus according to claim **1**, wherein

the display control unit is configured to control to display, if the imaging direction of the imaging unit corresponds to the panning rotational axis, the second panning direction guide indicating a captured image rotates along a circle around the imaging center by panning the imaging unit.

5. The control apparatus according to claim **1**, wherein

the display control unit is configured to control to display, if the imaging direction of the imaging unit corresponds to the panning rotational axis, the second panning direction guide instead of displaying the first panning direction guide.

6. A control apparatus for controlling an imaging apparatus capable of changing an imaging direction of an imaging unit in panning and tilting directions, the control apparatus comprising:

an acquisition unit configured to acquire a captured image captured by the imaging unit; and

a display control unit configured to control to display on the captured image a panning direction guide for indicating the panning direction which changes in curvature corresponding to the tilting direction, by superimposing the panning direction guide onto the captured image which is captured by the imaging unit pointing one imaging direction such that the panning direction guide does not pass through an imaging center which is an intersection of an optical axis of the imaging unit and a plane containing the captured image.

7. The control apparatus according to claim **6**, wherein the display control unit is configured to superimpose the panning

direction guide onto the captured image in accordance with a change in the imaging direction in a rotation direction in which the imaging direction is rotated around the optical axis.

8. The control apparatus according to claim **6**, wherein the display control unit is configured to set up latitude lines on a virtual spherical surface around the imaging apparatus and to superimpose, as the panning direction guide, the latitude lines onto the captured image arranged on the virtual spherical surface.

9. The control apparatus according to claim **6**, wherein the display control unit is configured to superimpose the panning direction guide onto the captured image when an angle between the panning rotational axis and the optical axis is equal to or less than a predetermined threshold value.

10. The control apparatus according to claim **6**, wherein the display control unit is configured to superimpose the panning direction guide onto the captured image when an angle between the panning rotational axis and the optical axis is equal to or less than a threshold value which changes with a viewing angle of the imaging unit.

11. A control apparatus for controlling an imaging apparatus capable of changing an imaging direction of an imaging unit in panning and tilting directions, the control apparatus comprising:

a panning operation unit configured to instruct the imaging apparatus to change the imaging direction in the panning direction;

an acquisition unit configured to acquire a captured image captured by the imaging unit; and

a display control unit configured to display, when an intersection of a panning rotational axis for rotating the imaging direction of the imaging unit in the panning direction and a plane containing the captured image is set as a panning rotation center and an intersection of an optical axis of the imaging unit and the plane is set as an imaging center, a panning direction guide on the captured image and display on the panning direction guide an icon for inputting a command to the panning operation unit, the panning direction guide indicating a part or the whole of a circle around the panning rotation center passing through a predetermined point existing on a straight line passing through the panning rotation center and the imaging center, where a distance of the predetermined point from the panning rotation center is longer than a distance from the panning rotation center to the imaging center.

12. The control apparatus according to claim **11**, wherein, when an angle between the panning rotational axis and the optical axis is equal to or less than a predetermined threshold value, the display control unit superimposes the icon onto the captured image such that a distance from the panning rotation center to the icon is longer than the distance from the panning rotation center to the imaging center.

13. An imaging control system comprising an imaging apparatus and a control unit for controlling the imaging apparatus,

wherein the imaging apparatus comprises:

an imaging unit configured to capture an image;

a panning change unit configured to move the imaging unit in a panning direction; and

a tilting change unit configured to move the imaging unit in a tilting direction, and wherein the control unit comprises:

an acquisition unit configured to acquire a captured image captured by the imaging unit; and

a display control unit configured to control to display, on the captured image, if an imaging direction of the imaging unit does not correspond to a panning rotational axis for rotating the imaging unit in the panning direction, a first panning direction guide for indicating that the imaging direction changes along a circle around a rotation center by panning the imaging unit, and to control to display, on the captured image, if an imaging direction of the imaging unit corresponds to the panning rotational axis, a second panning direction guide for indicating that the imaging unit rotates around an intersection of an optical axis of the imaging unit and a plane containing the captured image by panning the imaging unit.

14. A method for controlling an imaging apparatus capable of changing an imaging direction of an imaging unit in panning and tilting directions, the method comprising:

acquiring a captured image captured by the imaging unit; and

controlling to display, on the captured image, if an imaging direction of the imaging unit does not correspond to a panning rotational axis for rotating the imaging unit in the panning direction, a first panning direction guide for indicating that the imaging direction changes along a circle around a rotation center by panning the imaging unit, and to control to display, on the captured image, if the imaging direction of the imaging unit corresponds to the panning rotational axis, a second panning direction guide for indicating that the imaging unit rotates around an intersection of an optical axis of the imaging unit and a plane containing the captured image by panning the imaging unit.

15. A method for controlling an imaging apparatus capable of changing an imaging direction of an imaging unit in panning and tilting directions, the method comprising:

acquiring a captured image captured by the imaging unit; and

controlling to display on the captured image the panning direction which changes in curvature corresponding to the tilting direction by superimposing the panning direction guide onto the captured image which is captured by the imaging unit pointing one imaging direction such that the panning direction guide does not pass through an imaging center which is an intersection of an optical axis of the imaging unit and a plane containing the captured image.

16. The method according to claim **15**, wherein controlling to display the panning direction guide by superimposing the panning direction guide onto the captured image when an angle between the panning rotational axis and the optical axis is equal to or less than a predetermined threshold value.

17. The method according to claim **15**, wherein controlling to display the panning direction guide by superimposing the panning direction guide onto the captured image when an angle between the panning rotational axis and the optical axis is equal to or less than a threshold value which changes with a viewing angle of the imaging unit.

18. A computer-readable storage medium storing a program for causing a control apparatus for controlling an imaging apparatus capable of changing an imaging direction of an imaging unit in panning and tilting directions to execute a method comprising:

acquiring a captured image captured by the imaging unit; and

controlling to display, on the captured image, if an imaging direction of the imaging unit does not correspond to a panning rotational axis for rotating the imaging unit in the panning direction, a first panning direction guide for indicating that the imaging direction changes along a circle around a rotation center by panning the imaging

unit, and to control to display, on the captured image, if the imaging direction of the imaging unit corresponds to the panning rotational axis, a second panning direction guide for indicating that the imaging unit rotates around an intersection of an optical axis of the imaging unit and a plane containing the captured image by panning the imaging unit.

19. A non-transitory computer-readable storage medium storing a program for causing a control apparatus for controlling an imaging apparatus capable of changing an imaging direction of an imaging unit in panning and tilting directions to execute a method comprising:

acquiring a captured image captured by the imaging unit; and

controlling to display on the captured image the panning direction which changes in curvature corresponding to the tilting direction by superimposing the panning direction guide onto the captured image which is captured by the imaging unit pointing one imaging direction such that the panning direction guide does not pass through an imaging center which is an intersection of an optical axis of the imaging unit and a plane containing the captured image.

20. The storage medium according to claim **19**, wherein the method includes superimposing the panning direction guide onto the captured image when an angle between the panning rotational axis and the optical axis is equal to or less than a predetermined threshold value.

21. The storage medium according to claim **19**, wherein the method includes superimposing the panning direction guide onto the captured image when an angle between the panning rotational axis and the optical axis is equal to or less than a threshold value which changes with a viewing angle of the imaging unit.

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